POWER TOPICS CROSS-INDEX

STEAM GENERATION
POWER GENERATION
WATER POWER
DIESEL & GAS ENGINES
AIR CONDITIONING & HEATING
REFRIGERATION
PUMPS & COMPRESSORS
STEAM SERVICES
ELECTRICITY & ELEVATORS
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VOLUME 82 NUMBER 11

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NOVEMBER, 1938

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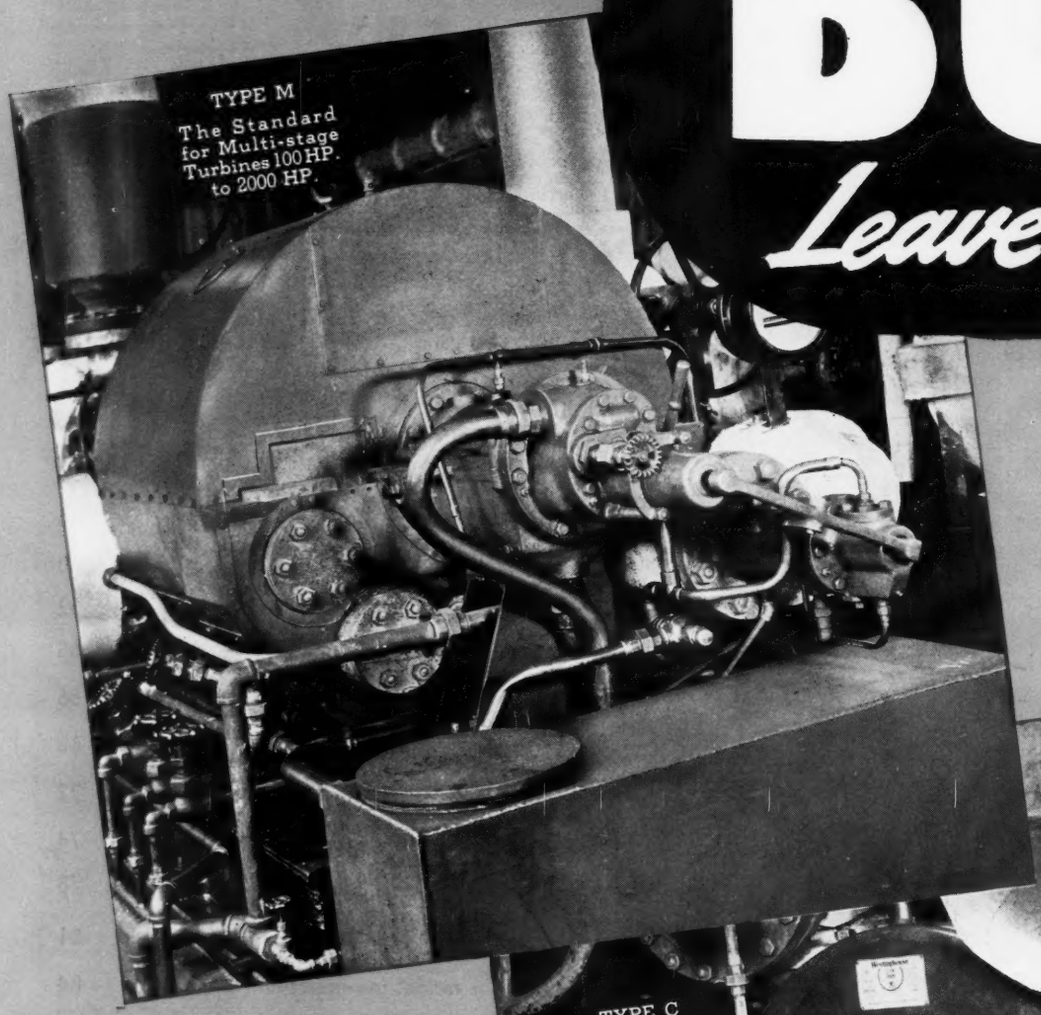
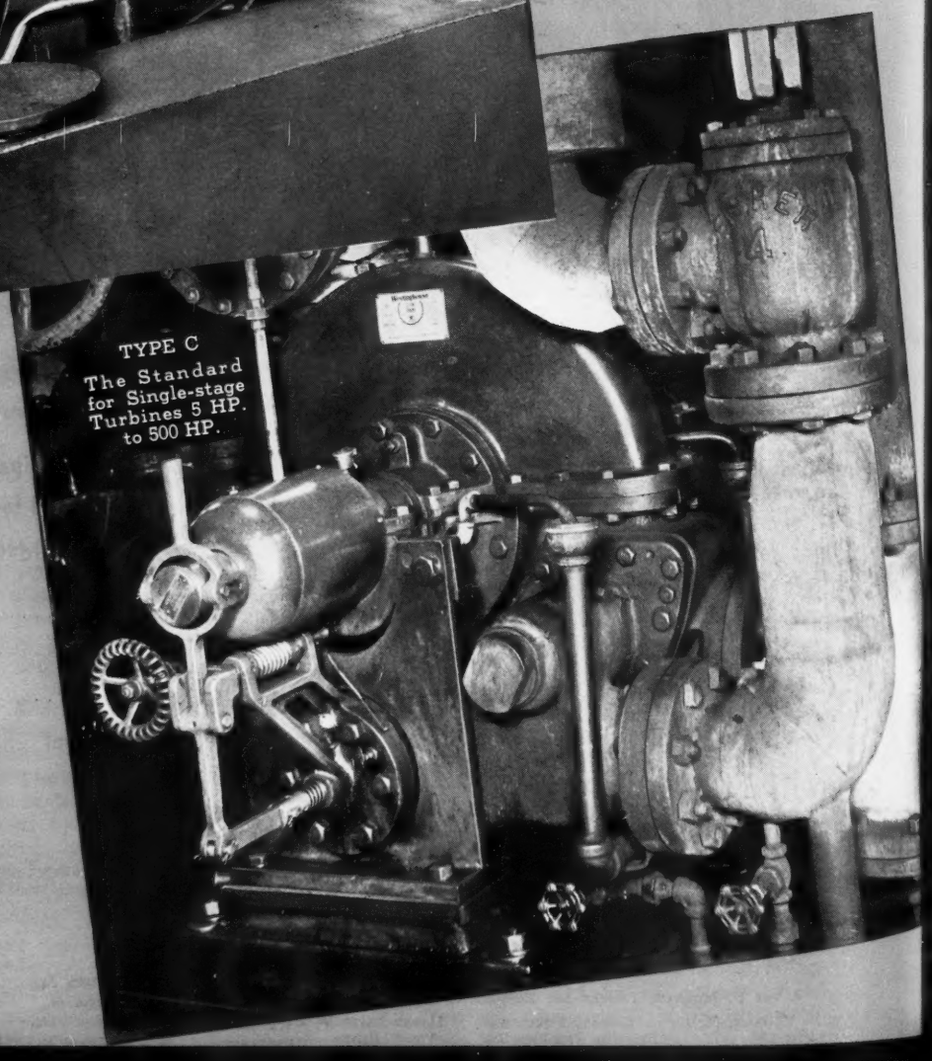
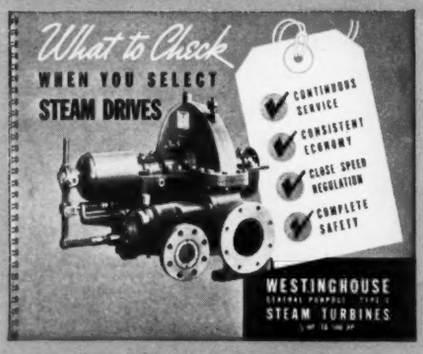


(Above) 900 HP Type M Turbine driving hot oil charging pump in large middle-west refinery.



(Right) Typical installation of Type C Turbine driving boiler feed pump.



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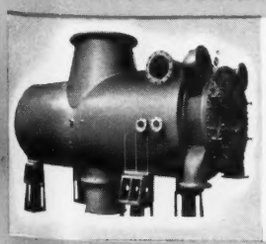

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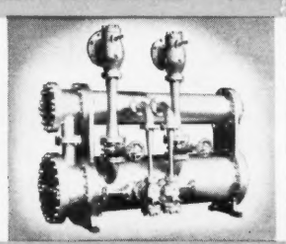

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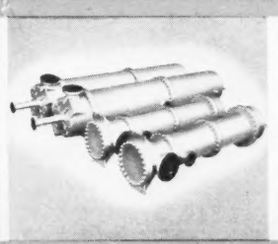

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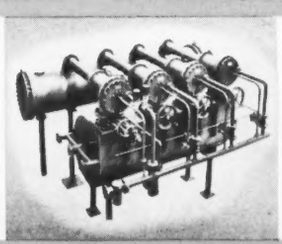

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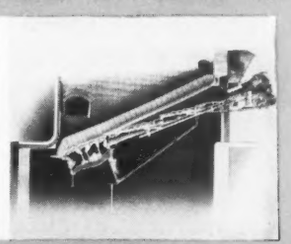

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Steam Service

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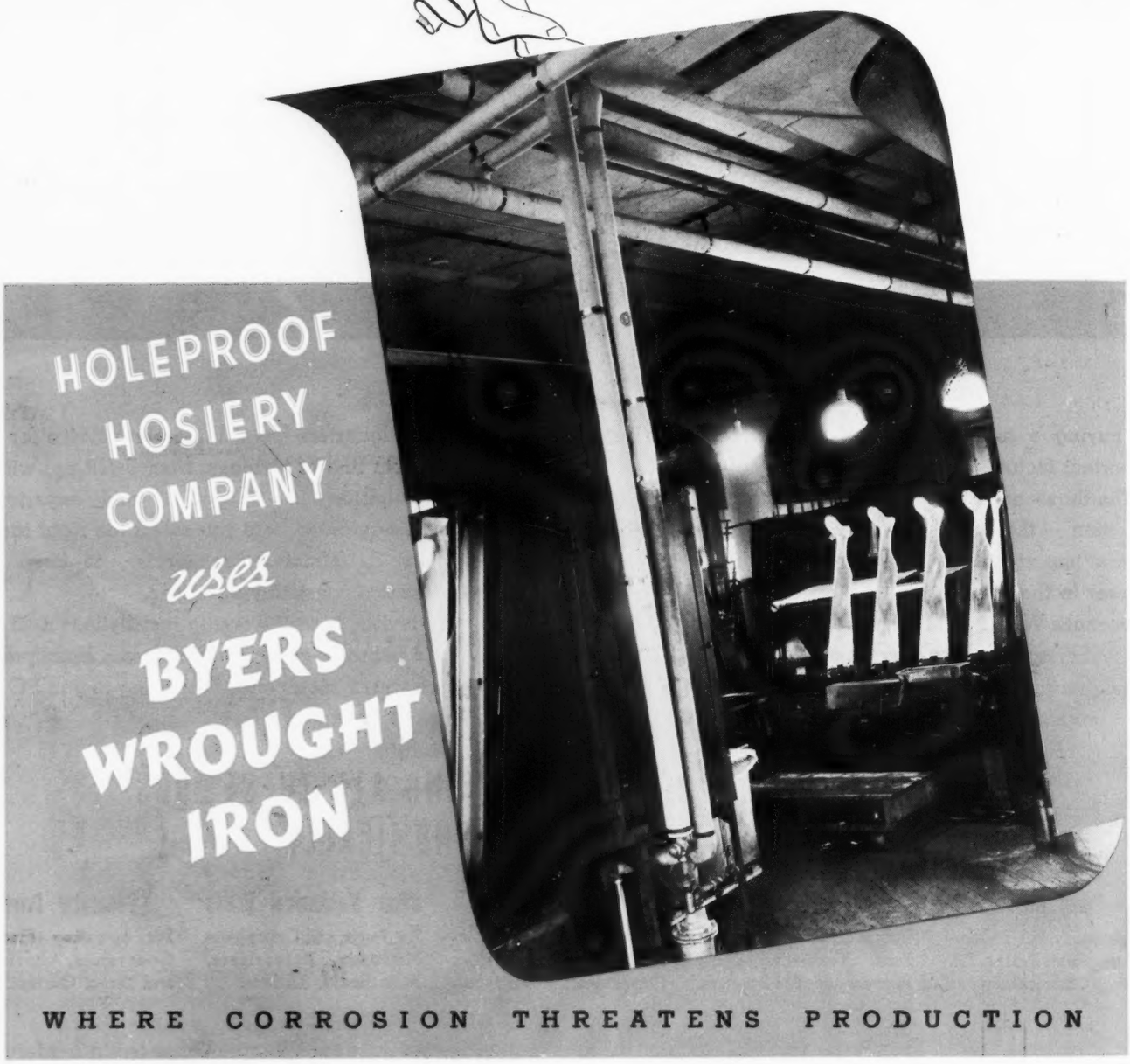

Known the nation over, Holeproof Hosiery has built a great business on the proven service of its product. It is thus only natural that the plant engineer, in selecting material, goes "By the record." He recently wrote, "We would be pleased to have your advice and recommendations as to what might be done to give us longer pipe life." His return lines from hi-pressure traps had lasted only three years.

Our Engineering Service Department asked for a sample of the boiler feed water . . . a sample of the condensate . . . and a section of the failed pipe. A study of these revealed the difficulties . . . and indicated the solution of the problem.

Typical of hundreds of cases regularly handled by our Engineering Service Department, this example illustrates how individual corrosion problems are studied. If you will write, outlining your problem, the Department will (1) determine the probable corrosive conditions; (2) relate these to similar conditions encountered elsewhere; (3) interpret the results in terms of experience gained in over 70 years' contact with corrosion problems; and (4) make recommendations . . . backed by actual service records. There is no cost or obligation. Write for the bulletin, "Wrought Iron in Piping Systems."

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POWER

Established 1882 PHILIP W SWAIN, Editor

1 Man = 420 Kwhr

IN HIS new book, "Nine Chains to the Moon," R Buckminster Fuller, the imaginative engineer who designed the radically different Dymaxion car and house, describes man as . . . "a self-balancing, twenty-eight jointed, adapter-base biped. An electro-chemical reduction plant, integral with aggregated stowages of special energy extracts in storage batteries, for subsequent actuation of thousands of hydraulic and pneumatic pumps, with motors attached. Sixty-two thousand miles of capillaries; millions of warning signals, railroad and conveyor systems; crushers and cranes . . . and a universally distributed telephone system needing no service for seventy years if well managed. The whole . . . mechanism guided with exquisite precision from a turret in which are located telescopic and microscopic self-registering and recording range finders, a spectroscope, etc, the turret control being closely allied with an air-conditioning intake-and-exhaust, and a main fuel intake . . ."

But this man, continues Mr Fuller, as a machine, is hardly worth even the 69 cents or thereabouts that chemists charge for the elements from which his body is built. Let's see what he really does amount to. Consider a husky American performing every working day the equivalent of carrying a 50-lb pack 3000 ft up a mountain slope. His day's output is then 0.057 kilowatt hours. If he works five days a week and fifty weeks a year, allowing two weeks off for sickness or vacation, this will amount to about 14 kwhr in a year or 420 kwhr in a working lifetime of thirty years. If he sold his energy at a low wholesale rate of 3 mills per kwhr now charged for hydroelectric power in some areas, he would earn $1.26 in his lifetime. But this rate may be too cheap, so let's grant him a retail rate of as high as 6 cents. Then his thirty-year output would bring $25.20.

It's pretty obvious from this comparison that man just isn't fitted to haul loads up mountains—or to compete with power-generating equipment in energy conversion. But fortunately, this computation neglects the worth of what Mr Fuller describes as the "turret," and details more fully thus: "Within the few cubic inches housing the turret mechanisms, there is room also for two sound-wave and sound-direction finder recording mechanisms, a filing and instant-reference system, and an expertly devised analytical laboratory large enough not only to contain minute records of every last and continual event of up to 70 years' experience . . . but to extend, by computation and abstract fabrication, this experience with relative accuracy into all corners of the observed universe. There is, also, a forecasting and tactical plotting department for the reduction of future possibilities and probabilities to generally successful specific choice."

The difference between man and other machines is that man can *think.* He is better fitted to design, build and operate the train that hauls loads up a mountain than he is to haul them himself. He is better fitted likewise to operate power-generating devices than to generate power.

These are simple and generally agreed-upon statements, but facts often forgotten. Most physical jobs, like handling coal, pumping water, and generating steam, machines can do better than man, *providing that man is there to direct them.* Our task now is a continuing one, to use the turret instead of the prime mover, to think and to control instead of to labor. It is a work of synchronization, synchronizing man and power to work together for mutual gain to both.

2 Boilers Replace 44

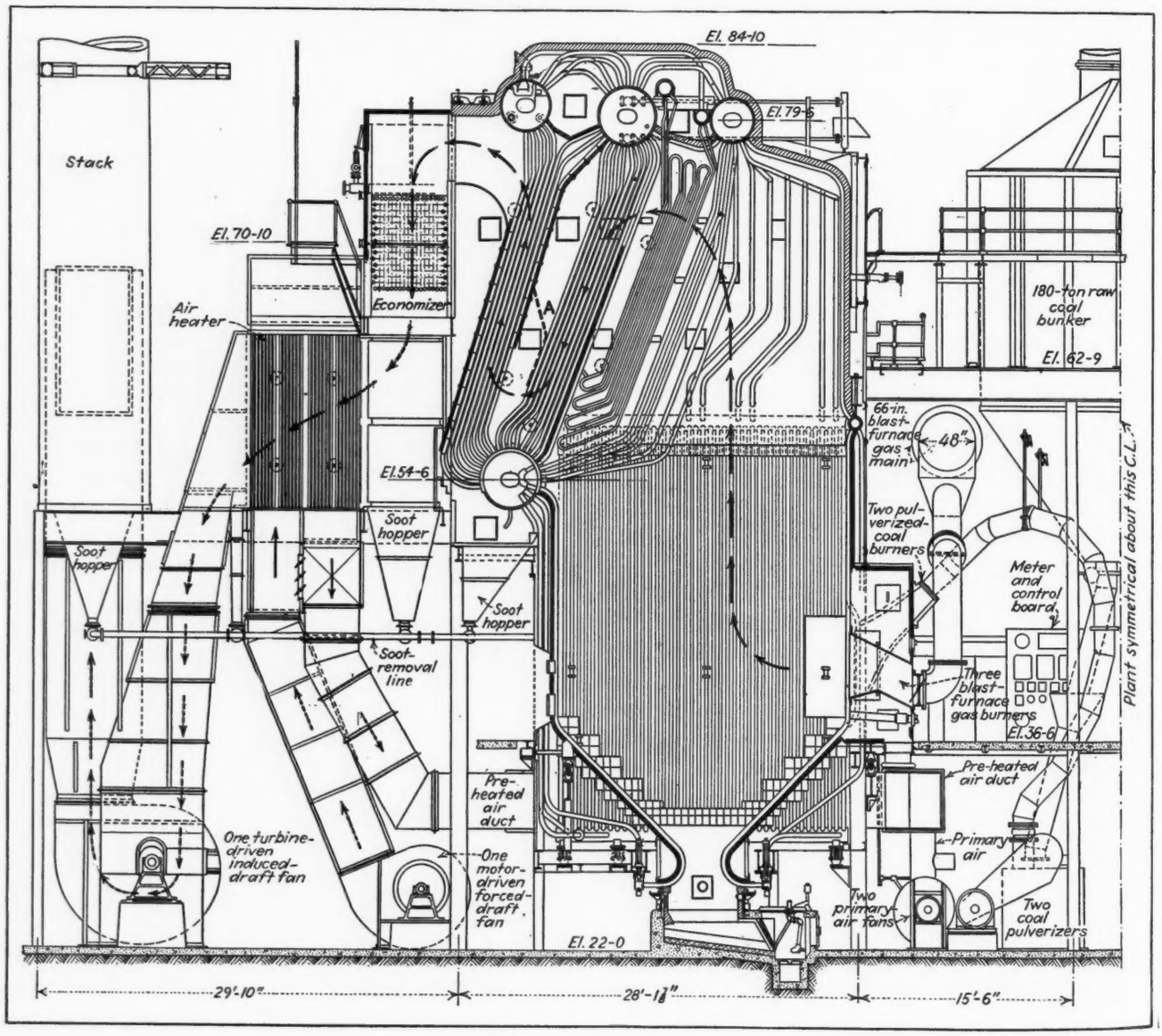
Several interesting features commend Dominion Steel and Coal Corp's new 450-lb topping plant to the attention of power engineers. It burns raw blast-furnace gas under boilers (the only plant we know of that does this), with pulverized coal to supplement gas. Two modern boilers and a new turbine-generator have increased yearly power output 80,000,000 kwhr with the same amount of gas burned under the old boilers

CAPE BRETON, Nova Scotia, is well known as the home of the late Alexander Graham Bell, the inventor of the telephone, for its scenic beauty and the Cabot Trail, and as a fisherman's paradise. Comparatively few, however, realize that in and around Sydney and Glace Bay is a great industrial region, the most eastern in North America.

The Dominion Steel & Coal Corp, the largest industrial company in Canada, has its steel plant at Sydney; at Glace Bay and other nearby towns are its coal mines. The steel mills produce 350,000 tons of pig iron and 425,000 tons of steel per year from iron ore brought from Newfoundland. Output of the coal mines amounts to 4,500,000 tons per year.

Within this industrial region dwells a population of 75,000, served by the largest power system in Canada supplied entirely by steam plants. This system comprises a

Fig. 1—A second boiler faces the one shown—both are fired with raw blast-furnace gas or pulverized fuel, or the two fuels in combination



22,000-volt loop transmission line about 50 miles long into which are tied four steam stations with an aggregate capacity of 50,000 kva. The largest power-generating station on the system is at the steel plant of the Dominion Steel & Coal Corp, Ltd, at Sydney, with 23,000-kva installed capacity.

Present steam and power-generating equipment represents 38 years of development. Four blast furnaces and 32 boilers were installed in 1900. During the following 35 years changes and additions were made in power-generating equipment until in 1935 the plant had the 32 original boilers plus four added in 1908, each having 2850 sq ft of heating surface, producing saturated steam at 150 lb gage, and burning blast-furnace gas, coal being used to supplement gas.

A second boiler plant built in 1912 consisted of eight 4800-sq ft boilers equipped with superheaters and fired with blast-furnace gas. Power-generating equipment included a 5000-kw and two 3000-kw turbine-alternators in one plant and three turbo-blowers for the blast furnaces in another, all operating on 150-lb steam.

A study made by the company's engineering department under the supervision of W S Wilson, chief engineer, showed that a very large increase in the amount of steam generated from blast-furnace gas could be made if a modern high-pressure boiler and turbine-generator plant were installed. The old boilers were in low settings and operated at an over-all boiler and furnace efficiency of about 55%, compared to 85% for a modern unit. The large number of boilers in two plants made operating costs high. In addition, the 36 old boilers had reached their last stage of usefulness.

Boiler Plant Location

Space was available in an abandoned blast-furnace blowing plant for new boilers. This building, which is 200 ft long, 64 ft high and 44 ft wide, had housed five 2000-hp vertical blowing engines with 100-in. blowing cylinders above the engines. There was also space in the turbine-generator building for an additional unit. Consequently, new equipment could be installed for cost of equipment only.

Engineering studies showed that a topping unit superposed on the old system would be best suited to the conditions, as it would permit using the 150-lb turbines, scrapping the 36 old boilers and retaining the 8 4800-sq ft boilers as standby. Steam and heat balances led to selecting steam conditions at the turbine throttle of 450 lb gage and 725 F total temperature, with the turbine exhausting into the 150-lb steam lines at a temperature of 525 F.

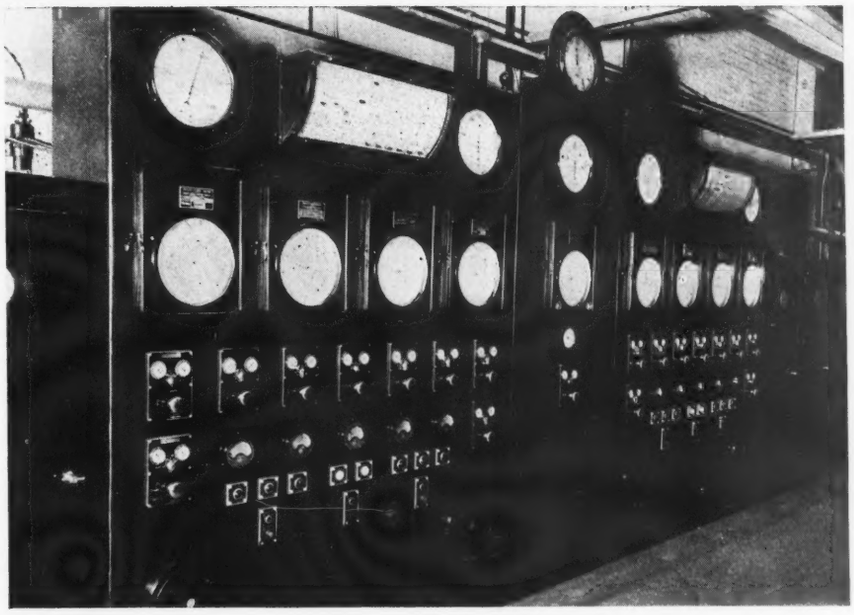


Fig. 2—On or near this panel are all meters and control equipment for operating the boilers continually under practical test conditions

Two 4-drum Stirling boilers were installed, each rated 186,000 lb of steam per hr continuously at 475-lb pressure and a total temperature of 750 F when burning pulverized coal, and 165,000 lb per hr burning raw uncleaned blast-furnace gas. They are equipped with return-bend economizers, air heaters and water-cooled hopper-bottom furnaces. These boilers with their high settings, giving a furnace volume of 11,400 cu ft, are the largest that could be installed in the space available, their tops coming within 14 in. of the roof trusses.

As shown in Fig. 1, the boilers are baffled for three passes with the front row of tubes arranged to form a slag screen. Furnaces are completely water cooled, including the hopper bottoms. Side walls are of stud-tube construction backed with plastic-chrome refractory. Front walls (to above the burners), rear walls and the furnace-hopper bottom are covered with Bailey blocks. Above the burners on the front wall the tubes are bare.

Blast-furnace gas is the major fuel, which means that quantity of flue gas is about 1.5 times as great as when burning coal. To insure high efficiency with the large volume of flue gas, both a large economizer and air heater were installed.

Gas is brought directly from the blast furnaces to the boilers at a temperature of 340 F through a 66-in. main. In front of the boilers this line divides into two branches, one for three burners in each furnace. The three gas and two pulverized-coal burners are set with their centers on a horizontal line across the furnace front, with a coal burner between 1 and 2, and 2 and 3 gas burners.

Coal is supplementary fuel and is burned only when there is insufficient gas and to start up a furnace. This fuel is received by railroad cars from mines about 12 miles away and is delivered into a 180-ton vertical circular bunker. Four chutes, each equipped with a coal meter, lead from the bottom of the bunker to four pulverizing mills, one for each of the two burners in each furnace.

Primary Air

Primary air is taken from the preheated-air ducts and discharged through the pulverizers by the primary-air fans. A damper between the main preheated-air duct and the fan tempers primary air to maintain a temperature in the pulverizers that depends on moisture in the coal, but which is normally around 200 F.

Blast-furnace gas is of low heat content, in this plant about 100 Btu per cu ft. This gas is burned just as it comes from the blast furnace, in which condition it contains 3.5 grains of dust per cu ft. With two blast furnaces in operation, 70,000,000 cu ft of gas is burned under the boilers per day. Consequently, about 17.5 tons of unburnable dust is taken into the furnaces each day, to which is added the flyash from the coal burned.

When a cold boiler goes into service it is first fired with pulverized coal and put on the line. Before turning gas into the connection between the 48-in. branches and the burners, air is forced out of the connection by filling it with steam. The steam is then shut off and a valve in a bleed line

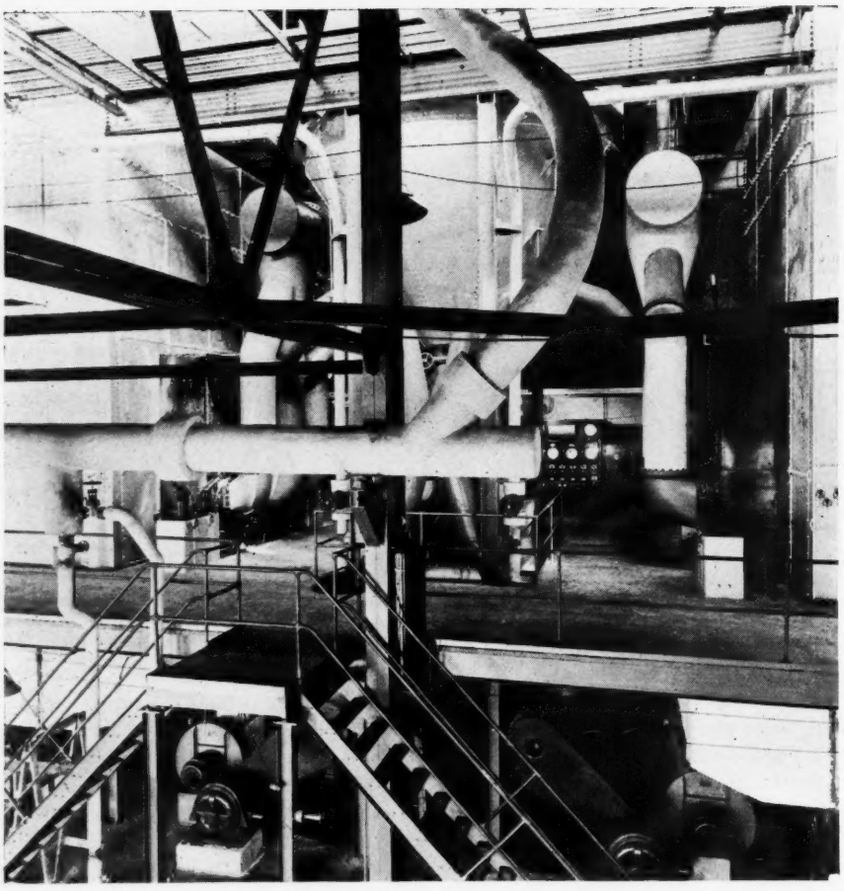


Fig. 3—General view of the operating floor between the two boilers, with coal pulverizers and primary-air fans below

running to atmosphere from a point near the burners is opened and the main gas valve opened. Discharge from the bleed line is then watched, and after all steam has been blown out and gas begins to flow, the bleed valve is closed. The steam insures that these connections contain nothing but gas when the burner valves are opened. This method of starting has been highly successful—not the slightest indication of a furnace explosion has occurred. Neither has any trouble been experienced in maintaining burner ignition when operating on 100% gas and at low ratings.

Slag Removal

Of course, with so much dust in the fuel, slagging on the tubes is a problem that has to be watched, but which is not serious. Two boilers are normally in service, except when one is out for inspection and repair. This permits wide latitude in firing, such as operating each on coal and gas or one on gas and the other on coal.

Experience has shown that if slag starts to form on boiler walls (there is no slagging on boiler tubes) when operating on both coal and gas, most of the slag will drop off if boilers are fired solely with gas for a while. Slag that cannot be removed in this way is easily dropped with an air lance. Soot blowers clean the tubes in back of the slagging rows.

When the boilers were installed, the second baffle had its lower end extended out toward the second bank of tubes as indicated by the dotted line at *A*, Fig. 1. This was done to direct gas down into the lower ends of the tubes, but it was found that dust lodged there. Straightening the baffle eliminated this trouble.

Now, a large part of the dust entrained in the flue gas is dropped in the hoppers below the mud drum, economizer air heater and stack. From here it is removed by a Hydrovac system. In the furnace bottom the ashes are quenched with water and removed by a Hydrojet sluicing system. Some trouble has been experienced with solids in the flue gas eroding certain areas on the induced-draft fan blades. How this problem has been solved will be described in another article.

The boilers have automatic combustion control and instruments by which they are operated under practical test conditions. All operations have been centered on and at the control and meter board, Fig. 2, on the operating floor between the two boilers. Part of this board can be seen in Figs. 1 and 3.

On the control board a 12-point draft gage connects to furnace draft, boiler outlet, economizer outlet, air-heater outlet, forced-draft-fan outlet, forced-draft-duct pressure, gas-burner air box, and coal-burner air box; also to differential across primary-air fan No. 1, differential across mill No. 1, differential across primary-air fan No. 2 and differential across mill No. 2.

A temperature recorder shows temperature of flue gas entering the economizer, gas entering the air heater, gas leaving the air heater and air leaving the air heater. Another recorder on each boiler shows temperature of water entering the economizer, water leaving the economizer, steam temperature at superheater outlet and feedwater flow to the boilers. Steam-flow air-flow meter and a water-level recorder are also provided for each boiler. A master recorder for the two boilers records steam pressure leaving superheater and gas pressure in the 66-in. main at the boiler plant.

Controls for Auxiliaries

Controls for all fans, pulverizers, pumps and other equipment associated with boiler operation are on the panel or alongside of it. By using mirrors, gage-glass indications and the condition of the fires as seen through a peep hole can be observed by the operator standing at the control panel. A dial indicator operated by the blast-furnace-gas-burner air controller on each boiler shows the operator the amount of boiler load being carried by gas.

Four coal pipes leave the bottom of the bunker in a group and terminate in funnels at the top of chutes leading to coal feeders on the pulverizers. These funnels permit the boiler operator to see that coal is going to the pulverizers. Gates in the coal pipes give the operator control of coal flow from the bunker and meters in the pipes record amount of coal going to each pulverizer. Incidentally, these meters have proven highly accurate and over long periods check closely with other means of weighing the coal. Thus, it is evident that the operator can obtain practically complete knowledge of boiler and auxiliary performance without leaving the control board.

Boiler operation is practically automatic, control being arranged to burn all available blast-furnace gas at all times and to supply any deficiency in fuel with coal. Automatic control adjusts air flow to the gas burners in proportion to gas pressure, which varies between 5 and 2 in. of water. If pressure drops below 2 in., gas burners are cut out and the boiler is fired entirely by coal. Steam pressure acting on the master con-

troller adjusts coal feed to supply the fuel necessary to supplement the gas. A mechanism takes into account the air supplied for burning the two fuels and automatically adjusts calibration of the air-flow pen so that the boiler meter at all times shows the correct steam-flow air-flow relation.

Steam from the boilers goes to a 27-stage, 3600-rpm, 9500-kva turbine-generator that exhausts into the plant's 150-lb steam main. This turbine has several unique features which will be described in a later article.

The new boilers now supply the entire steam load of the plant. In general, all steam passes through the high-pressure turbine, which acts as the reducing valve between the 475- and 150-lb systems. Any deficiency between the demand for 150-lb steam and exhaust from the high-pressure turbine can be made up through a reducing valve and desuperheater connected between the high-and-low-pressure systems, but usually the reducing valve and desuperheater come into service only when the high-pressure turbine is down.

The high-pressure unit operates in parallel with other machines in the plant, which is tied into the loop transmission system previously mentioned. Sufficient load is carried on the high-pressure plant to burn all available blast-furnace gas and to supply the 150-lb steam requirements through the high-pressure turbine. Of the low-pressure steam demands, blast-furnace blower turbines and plant auxiliaries are the first to be satisfied. All excess goes to the condensing turbine-generators and is used by them to supply power to the system load. Other stations on the system are loaded to obtain most advantageous operation of high-pressure boilers and turbine-generator at the steel plant, as this equipment is the most economical unit on the system.

The first high-pressure boiler and the turbine were started in October, 1937, and the second boiler a month later. Boiler-operating difficulties were anticipated and all have been solved so that operation of the plant is now highly satisfactory. The new boilers operate at a monthly boiler and furnace efficiency of 85% compared to 55% for the old boilers. The high-pressure turbine, in combination with the 150-lb steam load, has reduced steam consumption in the power plant from 16 to 10 lb per kwhr. Improvement in over-all boiler- and turbine-plant efficiency has reduced the Btu-per-kwhr consumption from 33,000 to 13,500. With the old boilers only 4,500,000 kwhr per month were produced from blast-furnace gas. Burning the same amount of gas under the new boilers produces 11,000,000 kwhr, an increase of 150% in power output.

Power expresses appreciation to W S Wilson, chief engineer, A P Theuerkauf, staff engineer, and A H Cuzner, superintendent of power plants for the Dominion Steel & Coal Corporation, for assistance in preparing this article.

Principal New Power-Plant Equipment

DOMINION STEEL AND COAL CORP, SYDNEY, NOVA SCOTIA

Steam-Generating Equipment:

Boilers and waterwalls — Babcock-Wilcock & Goldie-McCulloch, Ltd

Superheaters, economizers, air heaters, furnace and boiler settings, breeching, ducts, stacks — Babcock-Wilcox & Goldie-McCulloch, Ltd
Boilers, 2 4-drum Stirling, heating surface 14,756 sq ft; superheater, 4100 sq ft; waterwalls, 3434 sq ft; economizer, return bend, 2570 sq ft; air heater, tubular, max air temp 420 F, 12,300 sq ft. Rated max continuous steaming capacity, all coal fired, 185,000 lb per hr; all blast-furnace-gas fired, 165,000 lb per hr. Actual max steam capacity, all coal fired, 250,000 lb per hr; all blast-furnace-gas fired, 185,000 lb per hr. Working pressure, 475 lb g; total steam temp, 750 F; furnace volume, 11,400 cu ft; Btu liberated per cu ft per hr, 20,000 at max rating

Boiler heat insulation — Atlas Asbestos Co

Combustion Equipment:

Automatic combustion control — Bailey Meter Co, Ltd
Soot blowers — Diamond Specialty Co, Ltd
Blast-furnace-gas burners — Babcock-Wilcox & Goldie-McCulloch, Ltd
3 24-in. per boiler; cap. each 900,000 cu ft per hr
Pulverized-coal burners — Babcock-Wilcox & Goldie-McCulloch, Ltd
2 per boiler; cap. each, 14,000 lb per hr
Coal pulverizers — Babcock-Wilcox & Goldie-McCulloch, Ltd
2 per boiler; cap. each, 14,000 lb per hr
Pulverizer-driving motors — Canadian Gen'l Electric Co, Ltd
squirrel cage, 100 hp, 1165 rpm
Multiple V-belt pulverizer drives — Canad. Allis-Chalmers Co, Ltd
Pulverizer-motor control — Canadian Controllers, Ltd
Primary-air fans — Sheldons, Ltd
Primary-air-fan motors, 40 hp, s-c — Canad. General Elec Co, Ltd
Coal feeders, table type — Babcock-Wilcox & Goldie-McCulloch, Ltd
Forced-draft fans, 1 per boiler — Canadian Blower & Forge Co
217,000 lb per hr at 80 F, static press 10.5 in, inlet vane cont.
Forced-draft-fan drives — Canadian General Electric Co, Ltd
100-hp, 1165-rpm, squirrel-cage motors
Induced-draft fans, 1 per boiler — Canadian Blower & Forge Co
380,000 lb per hr at 485 F, static press. 8.5 in., 878 rpm
Induced-draft-fan drive — Babcock-Wilcox & Goldie-McCulloch, Ltd
300-hp, 3600-rpm, geared turbine
Reducing gears — Dominion Engineering Works, Ltd

Coal- and Ash-Handling Equipment:

Track hopper, 36-in. belt conv, skip hoist — Stephens-Adamson Mfg Co
Magnetic separator — Dings Magnetic Separator Co
Motors on coal-handling equipment — Bepco Co of Canada, Ltd
Motor controls — Canadian General Electric Co, Ltd
Conveyor belt — Dunlop Rubber Products, Ltd
Coal crusher — American Pulverizer Co
Coal bunker — Stephens-Adamson Mfg Co
Ash-handling system, Hydrojet — Allen-Sherman-Hoff, Ltd
Dust-handling system, Hydrovac — Allen-Sherman-Hoff, Ltd
Ash-sluicing pumps, 2 — Babcock-Wilcox & Goldie-McCulloch, Ltd

Piping, Valves and Fittings:

High-pressure pipe and bends — Crane, Ltd
Pipe heat insulation — Atlas Asbestos Co
Expansion joints — Foster Wheeler, Ltd
Traps — Crane, Ltd; Hopkinson, Ltd
Strainers — Elliott Co
Safety valves — Consolidated Ashcroft Hancock Co
Blowdown valves — Babcock-Wilcox & Goldie-McCulloch, Ltd
Non-return valves — Hopkinson, Ltd
Stop and check valves on feed lines — Hopkinson, Ltd
High-pressure valves — Hopkinson, Ltd; Edward Valve & Mfg Co; Crane, Ltd
Medium-pressure valves — Hopkinson, Ltd; Crane, Ltd; Jenkins Bros, Ltd
Low-pressure water valves — T McAvity & Sons, Ltd
Reducing valve, oil-operated (Brown-Boveri) — Swiss Elec Co, Ltd
Gas goggle valves — William Bailey Co

Feedwater System:

Water columns — Diamond Specialty, Ltd
Feedwater regulators — Bailey Meter Co, Ltd
Boiler-feed pumps, 3 — Babcock-Wilcox & Goldie-McCulloch, Ltd
2 turb and 1 motor drive; 220,000 lb per hr each; 660-lb head
Turbine drives — Babcock-Wilcox & Goldie-McCulloch, Ltd
238 hp, 3500 rpm
Motor drive, 250 hp, 3500 rpm, s-c — Canadian Gen'l Electric Co, Ltd
Motor control — Canadian Controllers, Ltd
Turbine-speed regulating valves — Bailey Meter Co, Ltd
Feed-pump governors — Babcock-Wilcox & Goldie-McCulloch, Ltd
Condensate-return booster pumps — B-W & Goldie-McCulloch, Ltd
2, motor drive, 700 gpm, 140-ft head
Condensate-return pumps, 2 — Smart, Turner, Ltd (Canada)
Motors, 2, 40 hp, 1750 rpm — Canadian General Elec Co, Ltd
Water-purification system (Cochrane) — Canad. Allis-Chalmers Co, Ltd
Deaerating feedwater heater — Canadian Allis-Chalmers Co, Ltd
345,000 lb per hr from 125 to 230 F (Cochrane)
Surge tank, 18,000 gal — Dominion Bridge Co
H-p heater, 350,000 lb per hr, 220 to 300 F — Foster Wheeler, Ltd
Steam control on heater — Foxboro, Ltd
Heater drain regulator (Cochrane) — Canadian Allis-Chalmers Co, Ltd
Feedwater-treatment proportioning pump — Hills-McCanna, Ltd

Meters and Instruments:

Boiler meter and control board — Bailey Meter Co, Ltd
Coal meters — Bailey Meter Co, Ltd
Boiler meters — Bailey Meter Co, Ltd
Steam flowmeters — Republic Flow Meters Co, Ltd; Bailey Meter Co, Ltd
Pressure and temperature recorders — Foxboro, Ltd
Feedwater flowmeters — Bailey Meter Co, Ltd
Water meters — Neptune Meter Co, Ltd
Boiler-water-level recorders — Bailey Meter Co, Ltd
Salinity indicator — Weston Electrical Instrument Co
Pressure gages, indicating — Peacock Bros, Ltd
Gas-pressure gages — Foxboro, Ltd
Oil-pressure gages — Jas Morrison Brass & Mfg Co
Thermometers, dial — Foxboro, Ltd
Thermometers, recording — Bailey Meter Co, Ltd
Draft gages, 12 point — Bailey Meter Co, Ltd

Generating Equipment:

Turbine, 7500 kw, 3600 rpm (Brown-Bov.) — Swiss Elec Co of Cda, Ltd
throttle steam conditions 450 lb, 740 F; exhaust 150 lb g
Generator, (Brown-Boveri) — Swiss Electric Co of Canada, Ltd
Turb connects directly to 9500-kva, 3-phase, 60-cycle, 6600-volt gen.
Desuperheater — Schutte & Koerting, Ltd
Desuperheater control — Taylor Instrument Cos, Ltd
Desup. pumps, 2 — Babcock-Wilcox & Goldie-McCulloch, Ltd
H-p steam separators for turbine, 2 — Dominion Bridge Co.
Generator air cooler (Brown-Boveri) — Swiss Elec Co of Canada, Ltd
Oil coolers (Brown-Boveri) — Swiss Elec Co of Canada, Ltd
Oil Separator — Crude Oil Engine & Equipment Co
Oil circuit breakers — Canadian General Electric Co, Ltd
Air compressors for boiler contol, 2 — Reavell & Co (Canada) Ltd
Air comp. for desuperheater, 2 — Canadian Ingersoll-Rand Co, Ltd
Electric controls — Canadian Controllers, Ltd
Safety switches — Bulldog Electric Co

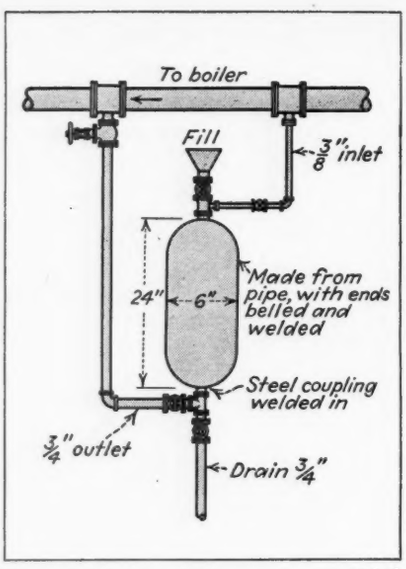


Fig. 1—All four boilers were provided with individual chemical feeders like this —total cost $55.00

Beware Hit-and-Run

Like any other power operation, internal boiler-water treatment can be handled by guess or by gumption, and the results vary from no benefits at high cost to comparatively low-cost scale prevention. This is a practical case study, with useful suggestion for operators of small plants

By K R WILLIAMS
Chief Engineer, Gibbs & Co, Inc

INTERNAL TREATMENT of boiler water to prevent scale can be a paying investment, or it can be costly as well as dangerous. "Costly and useless" would be a fair description of the procedure in many small plants. It is quite common for the engineer to dump into the hotwell an amount of compound determined by guess alone and then trust to blowing down to keep his boilers scale free. Then, when the boiler is opened and found full of scale, the compound is blamed and thrown out. After that, another is tried with the same slip-shod procedure and with similar results. And some times you will discover, if you investigate plants of this type, that the compound is never even used; is merely thrown away by the man who is supposedly responsible for the treatment.

A case of this kind recently came to my attention. The compound had been furnished by a well known chemical concern, but it never reached the boilers. It was merely doled out to firemen who then tossed it away as the easiest way to get rid of it. This situation was not discovered until an attempt was made to run down the cause of continued scaling.

Practically any plant with a large percentage of makeup can save a lot of money with properly controlled internal treatment, but it can't be done without careful attention to the job. The condition of the boiler water must be watched constantly. The water must be tested every day, particularly where load is variable. The compound used must be selected to fit the water, and the amount fed must be varied to suit the operating conditions. Properly regulated blowdown is another essential. To illustrate the importance of proper handling of internal treatment, let me review the results obtained in my present plant.

Steam is furnished by two 1250-sq ft B & W horizontal boilers and by two Erie City 2250-sq ft 2-drum vertical water-tube units. The extreme load variations from day to day may require from one to four boilers and individual ratings ranging from 100 to 200%. The entire steam output is used for process. Makeup ranges from 25% to about 80%. Condensate returns are less with the higher loads.

Excessive scale was only one of the many bad conditions existing in this plant when I took charge. Treatment cost was high, with nothing to show for the expenditure. With a steam output ranging from 135,000 lb to 145,000 per day, from 12 to 14 lb of compound was being used daily. Cost ran 7 to 8 cents per thousand gallons treated.

This compound was furnished by a company with excellent reputation and service facilities. Moreover, the company representative had been visiting the plant regularly at 10-day intervals, testing the water and recommending increases or decreases in treatment according to the results of his tests.

Making a Checkup

Naturally I called this man in for a check up. We soon discovered that his recommendations had rarely been followed by the plant personnel. A primary reason for the high cost of treatment was found to be excessive blowdown which, in turn, forced excessive use of compound. We agreed that daily testing would be necessary. The company would not buy a testing outfit, so I had to improvise my own with the help of the representative.

Starting out with a bottle of standard soap solution and an eye dropper to test boiler-water hardness, I soon assembled an incomplete testing set, mostly borrowed equipment. The representative supplied the chemicals and dropped in once or twice a week to check my results. Between us the cost of treatment was very quickly brought down to a reasonable point—in recent months to about 3.5 cents per thousand gal. Daily cost fell from $1.82 to $0.56. When the office saw these results I was allowed to purchase a complete testing kit.

In spite of this great improvement, continued close regulation was not giving the best results. In an effort to keep hardness low enough, we were allowing alkalinities to run too high. The formula was changed and I then had no difficulty in holding a good balance. If it was lost, it was very quickly brought back in line, generally within 24 hours. Very little scale formed.

We next went after the method of feeding compound. To replace "shotgun" feeding of all boilers through the feed-pump suction, I built individual feeders (Fig. 1) for each boiler. The entire cost, including outside welding, was only $55.00. These feeders quickly paid for themselves. The compound can be shot into the boiler quickly or regulated to feed over a period of time.

In a recent month the boilers became salted. In the absence of daily testing, this would not have been discovered until the next visit of the representative. We found it at once. In another day I had the representative in to check results and help me locate the cause.

We tested condensate sources and finally spotted the source of pollution

Internal Boiler Treatment

—three small kettles used for boiling salt water. As soon as we cut their returns out of the heater, pollution stopped. A few extra-heavy blowdowns soon had the boiler water back to normal.

The entire cost of equipment to bring about these results was:

Test cabinet	$16.00
Chemicals (testing)	6.00
4 Individual feeders	55.00
Total cost	$77.00

My estimates indicate that compound will cost us $104 less this year than last. This is not a large sum, but it is well worth the investment, if one considers the other savings as well. Clean boilers are saving a lot of fuel, as well as boiler tubes. Then there is a large water saving because daily blowdown now runs from 500 to 2500 lb per day instead of 3000 to 15,000 lb.

A lot of credit for the results we have obtained must be given to the cooperation of the representative of the chemical manufacturer. In small plants, particularly, the engineer can get much better results if he will work closely with practical experts.

Finally, it is worth noting again that this line of improvement was started without making any investment. Eventually, any course of continued improvement involves spending some money, but I have always found it far easier to sell an employer a new betterment idea of this sort *after* I have given him an actual demonstration of what can be done.

Exhaust Lines

Charles Addams in "The New Yorker." Reprinted with permission.

"Fertig here is one of our most reliable men."

Heat sufferers in the desert country of the West cool off with "desert coolers"—fans which force air through pads of excelsior kept wet by dripping water. Some units are "boughten," others homemade, but all bring relief from the hot dry air by evaporative cooling, particularly suited to the conditions. The pads also filter out dust and sand.

Power operators know hardfacing as a way to lick rampaging steam—miners now know it as a way to get more mileage out of hobnailed boots. Nails are faced with a cobalt-chromium-tungsten alloy, last 2-3 times as long as before. Now how about something to do the same for small boys' shoes?

Fuel oil can be given a rough test with no more equipment than two porcelain laboratory dishes. In one goes a sample of oil whose quality is known; into the other the same amount of oil to be tested. Both are ignited by heating or by burning gasoline on the surface. Comparison of the residue after complete burning indicates whether the new oil is better or worse than the known oil. Admittedly crude, this test does, however, give a quick check.

With statistics compiled by Petroleum Times indicating that the fighting forces of about 30 countries consumed a grand total of 8,288,000 tons of petroleum products in 1937, the frequently predicted oil shortage seems a lot closer. On the other hand, improved ways of making gasoline from natural gas, are estimated to have pushed back the end of U S resources by at least 20 years. These discoveries put natural gas on the same footing as petroleum as a source of gasoline.

Today's Diesel Practice

Housing the Plant

Sound building construction, adequate lighting, heating and ventilation, and intelligent layout of equipment all contribute to successful operation of a diesel plant

By ORVILLE ADAMS

MODERN DIESEL plants, in layout and design, are the product of two decades of engineering evolution and development. The haphazard assembly of machinery, inadequately housed and operated, characteristic of the early 1920's has given way to the best in engineering and architecture.

Local limitations, financial and physical, and the lag of public appreciation of municipal operation were factors which frequently compromised obvious engineering requirements, such as good building construction, provision for adequate lighting, heating, and ventilation, suitable auxiliary equipment, reasonable space for machinery, and conveniences to operation. For the most part, these requirements are amply met in the newer plants.

Plants included in this survey have evolved through two or more phases of rebuilding and replacement, as original installed capacity was multiplied many times to keep pace with growing demands for light and power. Through the years, new and larger engines replaced original units, modern buildings were erected, and the best in engineering practice applied as conditions and limitations permitted.

Many smaller towns require only limited space for administrative offices, fire-department apparatus, and storage of supplies. These can frequently be combined in a single building with the power plant and waterworks, a concentration of municipal activities that has proven practical and efficient. For example, the attractive building at Farmersville, Texas, shown in Figs. 1 and 2, houses the Mayor's office, water and light office, fire department, and storage space. Fig. 2 illustrates provision for possible extension.

Many diesel plants have been added

Fig. 1—Farmersville, Texas, building houses mayor's office, fire truck, garage and repair shop, and storage, as well as power plant

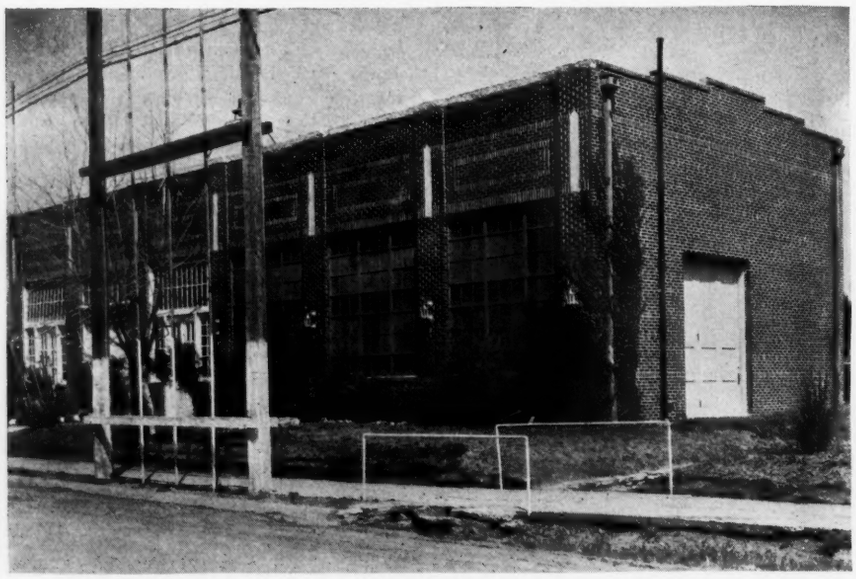


Fig. 2—Expansion is provided for in the Farmersville building

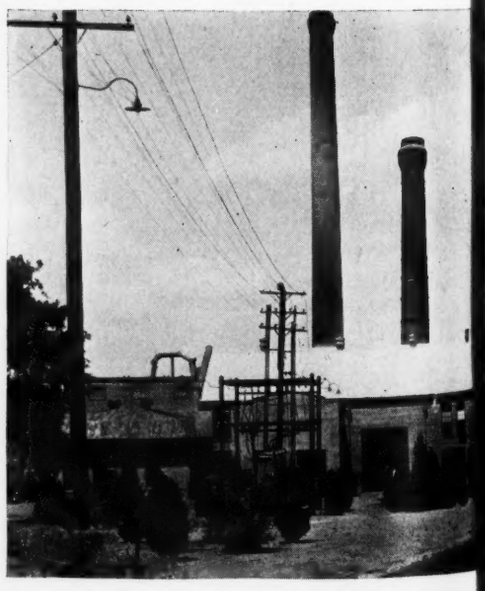


Fig. 3—Exterior of Greenville, Texas, plant

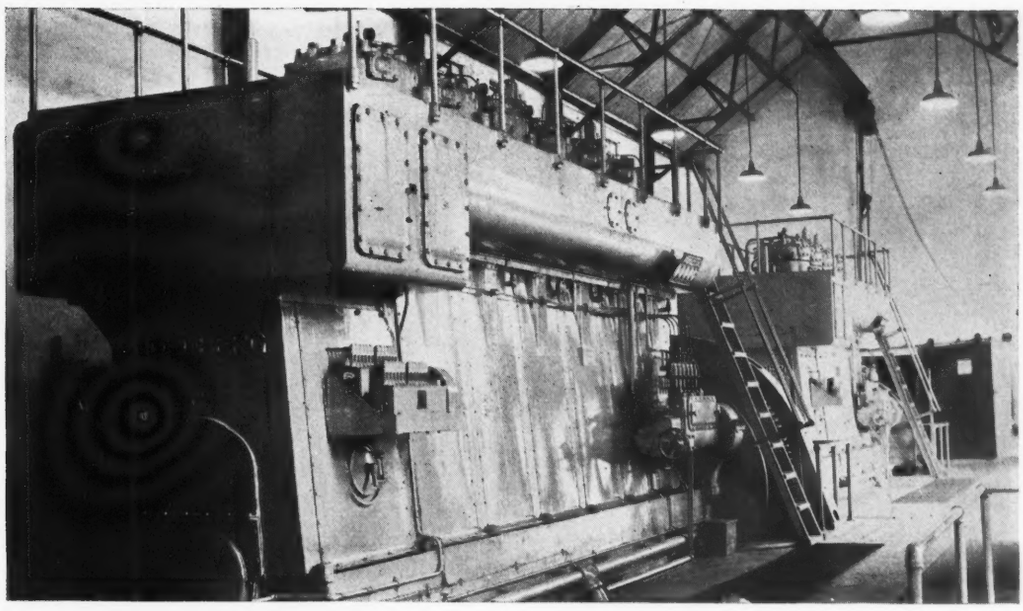


Fig. 4—This is Greenville's spacious, well-lighted engine room

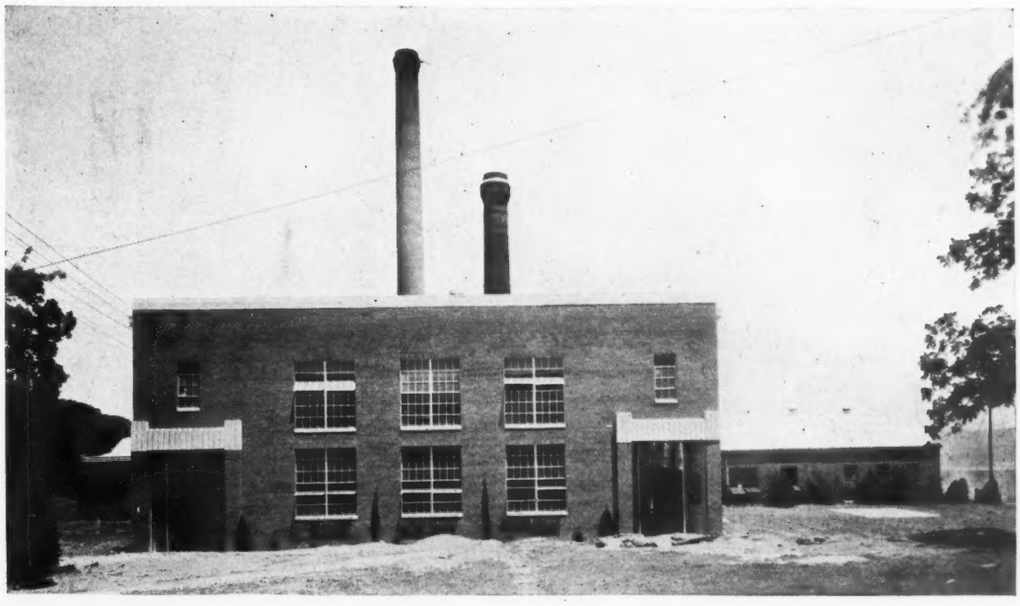
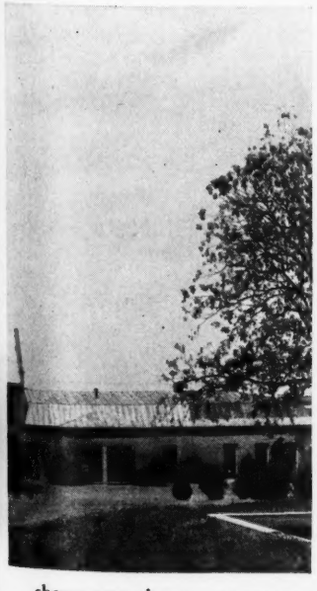


Fig. 5—Load growth in Greenville meant adding capacity, so this building was added in front of those shown in Fig. 3



shows attention to appearance

Fig. 6—New building houses a 2000-hp engine with space for two more. Note excellent layout

Fig. 7—Forest City, Arkansas, building is modern in design, with large window area for lighting and ventilation

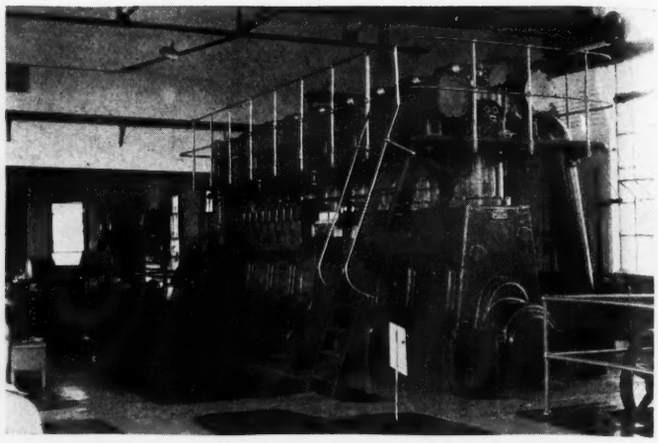


Fig. 8—Floors in Forest City plant are polished concrete, with piping in trenches. Engines are arranged end to end

to existing steam plants or have taken the place of steam plants. This was the case at Greenville, Texas, where a power and light plant has operated for more than fifty years. Five years ago, a 1000-hp and a 1500-hp diesel were installed and a recent addition included a similar unit rated at 2000-hp. Steam turbines used for many years are still maintained for standby service. A general view of the plant is shown in Fig. 3; the center section houses the diesels installed five years ago, and was added to the older steam plant buildings.

Excellent Lighting

The new 2000-hp unit is in an extension built recently, in front of the building shown in Fig. 3. The extension provides space for two more units expected to be needed in the next few years. Fig. 6 shows the workmanlike arrangement and space for future development. All auxiliary equipment is located in basement, with only the switchboard and tool rack on the engine-room level. Excellent lighting is indicated by the fact that Fig. 6 was taken without artificial lighting, and with only a minute's exposure.

Present plants in many places have buildings that are new throughout, built adjacent to or as a part of the original buildings. A case in point is Forest City, Arkansas, where three large engines have been installed during the last ten years. The building, shown in Fig. 7, combines high ceiling and tall windows. In warmer climates, radiation from the engine is a problem which cross-circulation solves without recourse to exhaust fans. On the other hand, arrangement must be such as to retain sufficient radiated heat in winter months to keep plant warm for operators.

The interior view, Fig. 8, shows polished concrete floors, with trenches for piping and drainage. Polishing or otherwise surfacing floors facilitates cleaning and stimulates good housekeeping. Floors like those in Fig. 8 can be kept spotless and usually *are*.

Fig. 11—Lubbock, Texas, has largest diesel plant in state, is proud of attractive building

Denton, Texas, with 5000 installed horsepower in five units, is an example of the larger plants that combine waterworks, power plant, storage for electrical, waterworks. and sewage supplies, and a complete machine shop. In this case, diesels replaced large natural-gas engines used for many years, and the building was constructed a section at a time, over the machinery. Careful shoring made it possible to work without shutting the plant down.

Looking at Fig. 9, store room and machine shop are on two sides of the plant, so additional lighting and ventilation at the center is obtained by means of roof-type overhead bays. Interior views show effect of combined lighting from overhead bays and side windows. Again excellence of lighting demonstrated is by ability to take pictures, with short time exposure, and without artificial light.

Lubbock, Texas, operates the largest municipal plant in the state, Fig. 11. The original power plant, housing seven engines installed 15 and 20 years ago, was more or less unchanged, and a new plant was built nearby, several years ago. The older plant is operated for peak load and standby. Tall and well-lighted, there is ample space for each unit, good lighting and ventilation, offices for chief engineer and superintendent, wash rooms, lockers for the operating crew, and ample storage for repair parts and tools. Careful maintenance keeps floors and foundations spotlessly clean.

Looking over these typical Southwestern plants shows that general appearance (including architecture and landscaping) and emphasis on mainte-

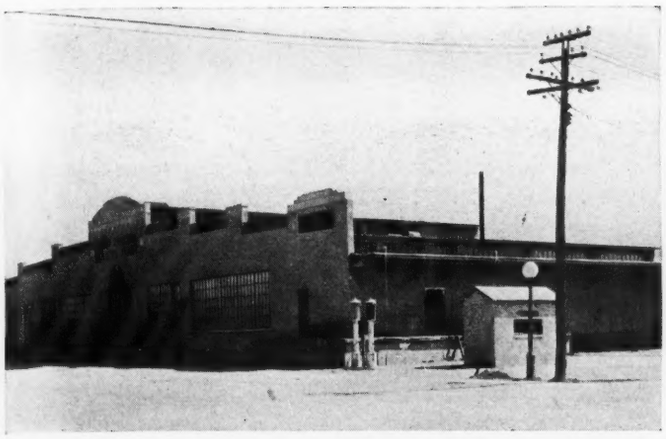


Fig. 9—Denton, Texas, plant has overhead bays, increasing natural lighting and ventilation in a wide single-story building

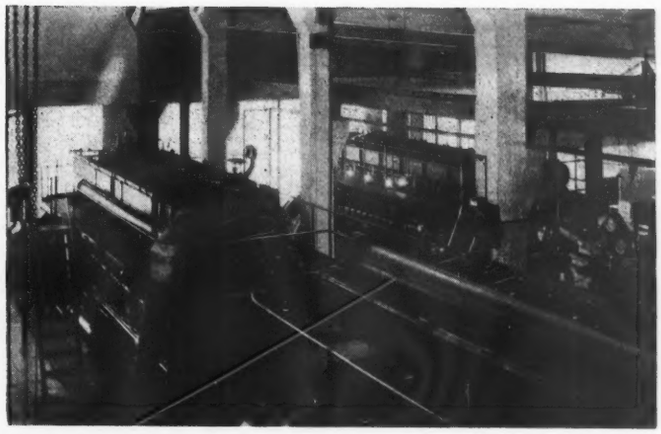


Fig. 10—Interior view of Denton plant shows compact arrangement of 1000-hp engines

nance of clean and orderly yards have become recognized requirements everywhere in the last few years. For the most part, the plants are in the more desirable sections of the city, where they are under the eyes of the citizens, and in many cases, the plants are show places of the town.

Operating men associated with these plants have been on the job for many years, in many cases since the commencement of the original plants, and through hard work and considerable thought, they have overcome or successfully compromised with difficulties, and by so doing have contributed to the present high standards of layout and construction.

Strange as it may seem, rapid technical and engineering developments which have made today's diesel practice what it is, have found wider acceptance in the municipal plant than in the industrial. Municipal plants included in this survey are typical examples of leadership in the field of diesel power-plant engineering.

Figures on rate of growth and demand for power indicates additional units every year or so to meet loads in prospect. Much future improvement in practice is in prospect, since no one claims perfection has been attained. Chief engineers in most plants point out other desirable features hoped for but at present denied. In nearly every plant one visits, improvements are being made, an oil-reclaiming system is being added or a fuel-oil heating system, a closed cooling system, a new and improved switchboard, additional apparatus for maintenance work such as strain gages, better machine shop equipment, heat recovery equipment, and numerous other items. So, in plants all over the country, today's diesel practice is slowly evolving into tomorrow's.

To POWER MEN EVERYWHERE ★ ★ ★ ★

The editors announce a Handbook of Hookups, to be published in December

THE ENDURING RECEPTION accorded *Power's* Hookup Number of 1930 has been a source of lasting satisfaction to its editors. But technical progress never ceases, and the time has come for a completely new Hookup Handbook, keyed both in content and presentation to today's most advanced practice. This will come to all *Power* subscribers as a 48-page section in the December number.

To make them easy to visualize, understand and use, more than 60 hookups will be presented in three dimensions, as photographs of actual models. A special paper and printing process will be used to bring out the full value of the photographs. This will be a working handbook, designed as a practical foundation for plant design and improvement.

To power men everywhere, the editors offer this handbook of hookups as their contribution to clear thinking, sound design, and the saving of power dollars.

PHIL SWAIN, *Editor*

Brains Rebel Against the Coal Shovel

Progress of modernization has brought about a wide range of coal-handling systems to suit the requirements and pocketbooks of almost all plants. Here are examples of economical layouts for moderate-size plants

By ALPHONSE F BROSKY
Engineer, The Jeffrey Manufacturing Co

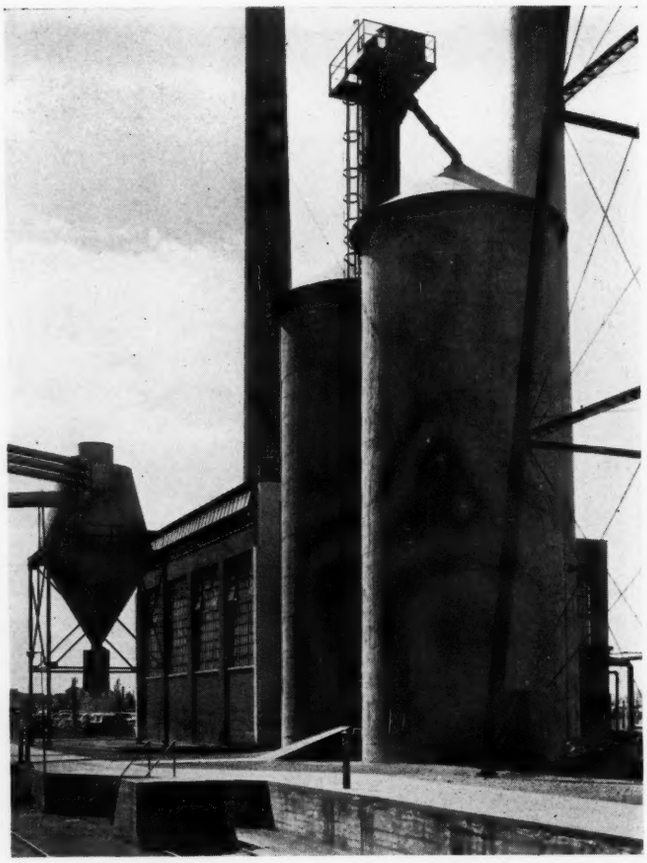


Fig. 1—Apron-conveyor, bucket elevator and two 500-ton silos solved coal-handling and storage in this plant

YEARS AGO it was common to hear owners of moderate-size steam power plants say: "We can't afford to equip our boiler house with coal-handling machinery, for even the simplest system costs too much for us." But today the small-plant owner can't afford to say that. Progress of modernization has brought about the development and application of a wider range of coal-handling systems to suit the requirements and pocketbook of almost any plant owner.

Plant management and plant location have changed other aspects of the problem. Sprawling, carelessly kept plants at the edge of town have been liquidated by aggressive competition, this because compact orderliness begets efficiency and economy, and because appearance helps to sell goods and services. Mounting taxation must also be considered, which, when added to appreciated land value, puts ground space at a premium. The ability of the coal producers to fill orders as currently needed also favors mechanical handling and protected storage at the smaller plants. Little wonder, therefore, that the exposed coal pile and wasteful handling methods are fast disappearing from small plants.

Large plants long ago ceased to hold a monopoly on the advantages of scientific management—continuous orderly production, motion and time economy and other benefits. As the field of scientific management has spread, it has reached down further and further to include the smaller plants. In the small plant, as well as in the large, regular economical production calls for uniform output of steam for processing and power. By assuring a steady flow of coal to the boilers, mechanical handling assumes an important role in the accomplishment of this demand. Modern combustion and control equipment does the rest. Economies in the confines of the steam plant are savings added to profits from manufactured goods.

Some Typical Layouts

Though standard equipment is generally used, seldom are two layouts made exactly alike since plant design and available space are governing factors. Whether live storage shall be provided inside the plant, or dead and live storage both shall be kept outside and whether ground storage also shall be provided are questions which cannot be discussed satisfactorily even in general terms. But a few typical jobs can be cited to illustrate modern trends.

Not a few industrial plants with moderately small to small coal requirements have gotten away from storage within the plant and also from ground storage so far as possible. They have followed the dictum: "Store skyward —in silos." This simple method is relatively inexpensive, particularly when applied as an addition to an existing plant. It requires no tie-in with the boiler-house structure, occupies a minimum of space and provides for live and dead storage.

Twin Silos

An example of this is the installation of twin silos and bucket elevator, Fig. 1, made at an automotive-parts manufacturing plant. On this job each silo provides storage space of 18,840 cu ft (approximately 500 tons). Only that silo nearest to the boiler house wall is provided with live storage space, about 70 tons, with dead storage beneath. This silo serves the current need while the second silo provides reserve or dead storage only. The handling equipment is rated 40 tons per hour.

Coal is dumped from railroad cars into a standard track hopper equipped with chute and regulating gate. From there it is carried by a 24-in. apron conveyor to a bucket elevator which lifts the coal to the top of the silos. There, distribution is made by a 2-way chute with valve either to dead or live storage

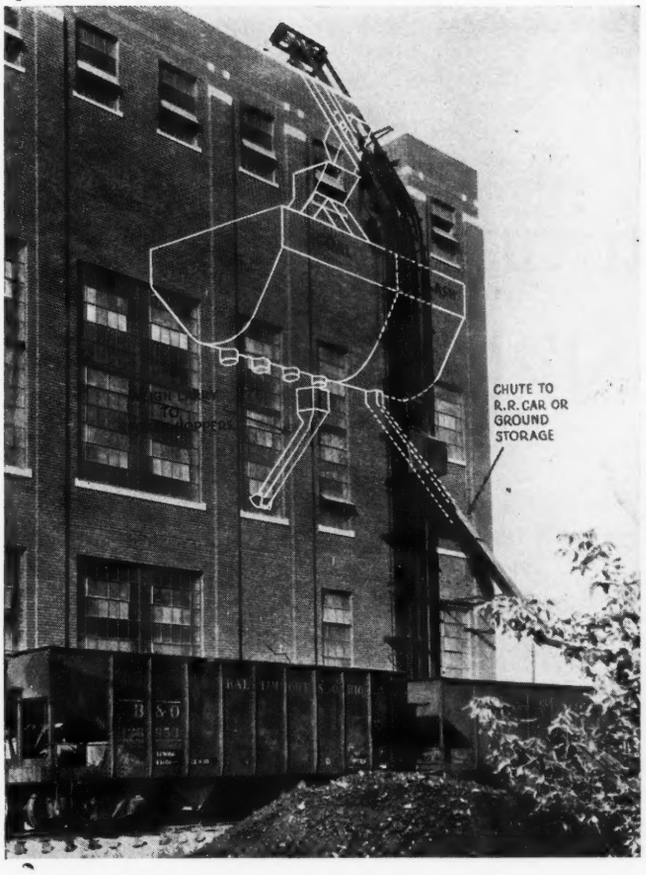


Fig. 2—An automatic skip hoist delivers either coal or ashes to inside bunkers. Dead coal storage is outside

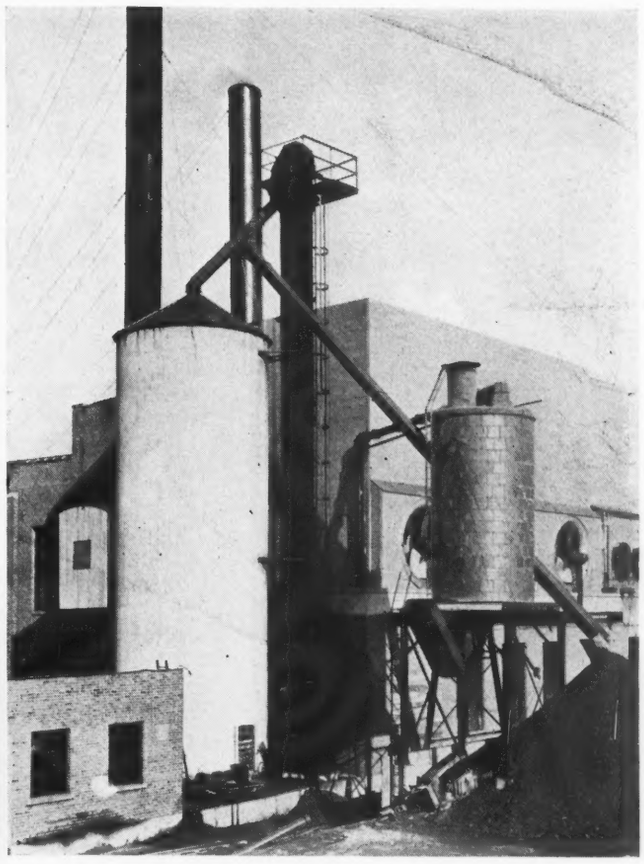


Fig. 3—Here a bucket elevator handles either coal or ashes, which are stored in outside silos

in one silo, or to dead storage in the other. From live storage, the coal is delivered by chute through the boiler-house wall to a motor-propelled weigh larry, thence to the stoker hoppers. Reclamation from dead to live storage is accomplished in the usual way by chutes to the elevator boot. These chutes are controlled by vertical slide gates operated from the outside.

Inside Live Storage

If a new steam plant of moderately small capacity is to be erected from the ground up, the idea of live storage in an inside bunker is often viewed with favor. Such an installation, with an automatic skip-hoist system of handling coal and ashes, operating in the municipal plant of Piqua, Ohio, is shown in Fig. 2. One feature of this job is that the self-cleaning characteristic of the skip permits handling of coal and ashes, in turn, without contamination. Skip car holds 27 cu ft, travels 122 fpm to make a round trip in 1.5 min, and handles coal at the rate of 20 tons per hour.

When handling coal, the hoist is full-automatic. Once the start button is pressed, the skip continues to travel up and down, carrying coal from track hopper to storage bunker, until it is stopped. Coal is fed from the track hopper to the skip bucket by an automatic loading gate. The storage bunker holds 75 tons of coal and 25 tons of ashes. Coal is taken from the bunker to the stoker hopper by a standard 1-ton weigh larry.

Ashes are put into bunker storage by skip-loading from a 21-cu ft dump-type ash car. The loading point for this operation is outside a door at basement-floor elevation. Ashes are carried from storage to railroad car by chute. When handling ashes, the hoist operates semi-automatically. Electrical interlocking guards against discharge of coal into the ash pocket or ashes into the coal pocket. One man operates the skip and spots the railroad cars.

Ground Storage

To put coal into ground storage, the ash pocket is emptied; and this pocket then receives coal from the skip and discharge through the chute to the outside. The end of the permanent chute is fitted temporarily with a section of pan which leads to a portable conveyor on the storage ground. From ground storage, coal is returned to the track hopper by a hand-held scoop which is pulled by a cable attached to the skip rope.

This same layout may be adapted to the handling of 80 to 100 tons of coal per hour by increasing the size of the skip car proportionally and using two cars, or a balanced hoist.

It is even feasible to arrange a small-capacity system in a simple manner for automatically controlled handling and weighing of the coal from storage to stoker, as in Fig. 3, which shows an installation made at a mid-western industrial plant. This installation includes the use of a constant-weight feeder which measures and records the weight of coal passing to the stoker hopper. Daily consumption is about 60 tons of nut and slack coal. Coal from railroad cars is received by a track hopper and fed by apron feeder to a bucket elevator which discharges into the silo. This silo, with a total capacity of 200 tons, has a live-storage shelf beneath which is the "spill" or dead-storage zone. The elevator transfers coal in the bin from dead to live storage as needed. From live storage the coal is carried by chute to the constant-weight feeder and thence by screw conveyor to the stoker hopper. In this last are a high- and low-level Bindicator for starting and stopping the feeder and screw conveyor which carries at the rate of 10 tons per hour when continuously fed. Present requirements, however, keep these in operation about one-third of the time.

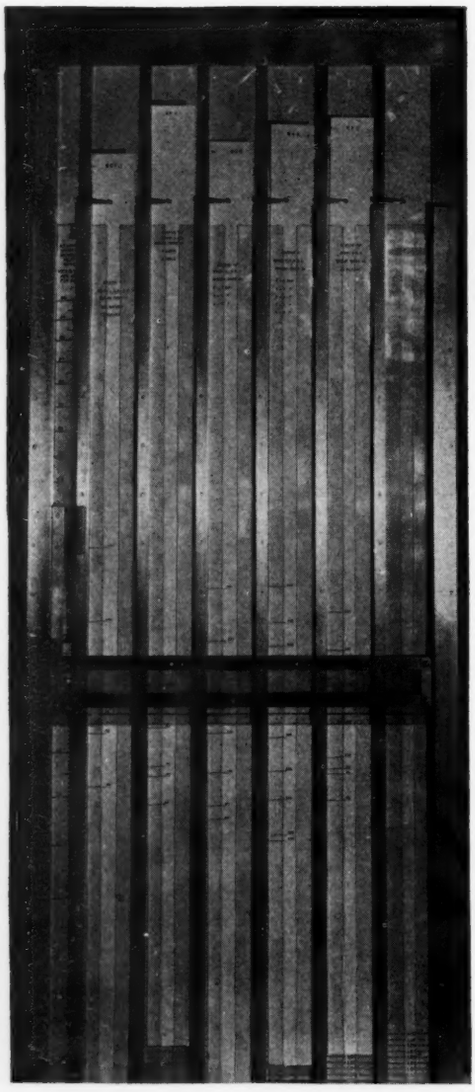


Fig. 1—Slots accommodate six paper strips, one for each generating station. Station load is read directly from the slider

Station-Loading Slide Rule

Ingenious paper-scale device determines proper load schedules for complex system by quick mechanical operation. Requires only fraction of time formerly needed for calculations

By H H JOHNSON and M S UMBENHAUER
Consolidated Edison Co of New York

INCREMENTAL heat rates have been universally accepted as the correct method of load division between turbine-generator units within a central station and between the several stations of a system. Incremental heat rates are simply calculated values of additional heat input required to carry an extra kwhr. Theory and application have been thoroughly treated by Steinberg and Smith in March, April 1934, *Electrical Engineering.*

To effect maximum economy in fuel consumption for a many-station system it is necessary to follow frequently changing system conditions. The most important of these changes are: outage of equipment, effect of seasonal temperature differences, and variation in relative fuel costs. Due to the vast number of combinations of generating equipment normally operated, a great number of loading schedules are required. In attempting to follow these changes, it has been found impractical, even with the use of the approximate method described in the above mentioned paper, to produce the necessary loading schedules for a given set of system conditions before new conditions prevailed.

The former practice in the preparation of loading schedules required computing and plotting the incremental heat rates for the many combinations of generating equipment at each station, corrected for the prevailing conditions, and relative fuel price. Next the various curves for different equipment combinations at a station were replotted on a sheet with the equipment combinations operating simultaneously at the other stations. In producing the load schedule from these curves it was necessary to find an incremental-heat-rate ordinate that indicated a load allocation between stations at the desired schedule system load. To produce a single complete loading schedule in this manner required from 4 to 8 man hours.

Since on a many-station system a great number of loading schedules are required to cover the many probable combinations of units that may be run, it is obvious that the required set of schedules could not be produced in time to meet the many changing conditions without a large force.

To take advantage of improvement in economy by closely following changing conditions, a faster and simpler method for producing loading schedules has been developed and put in practice. To date it has proven satisfactory.

In this method three major steps are involved. First, the preparation of incremental-heat-rate curves, second, mechanical application of the relative fuel cost by means of a new device; third, simple and rapid production of loading schedules.

Incremental heat rates are established in the following manner. The basic heat-input—load-output curves for various turbine combinations at each generating station are computed for the different seasonal conditions. The heat-input—heat-output curves for the boilers operating at each generating station are also computed for the same conditions. From these, with proper adjustments for station auxiliary use, the incremental heat rates can be quickly established for any combination of turbines and boilers.

A Shortcut

By means of this device, (described later), the station incremental heat-rate curves need not always be plotted, and never need be replotted for variations in relative fuel costs. It has been found that in the majority of cases the station input-output curve, developed as above, will consist of a series of straight lines whose slopes increase as station load in-

creases from one turbine-valve opening to the next. This indicates a flat-stepped incremental-heat-rate characteristic. The necessity for plotting the incremental-heat-rate curve is eliminated.

Although the incremental heat rates indicate the most efficient load division, it is necessary to convert the incremental heat rate to an incremental cost rate for maximum economy. This is accomplished by multiplying station incremental heat rates by the ratio of the fuel cost per heat unit at each station, to the fuel cost per heat unit at the station with the lowest cost per heat unit.

To compare station incremental cost rates for making load schedules, paper "loading" strips are prepared, Fig. 2. Loads are tabulated corresponding to various incremental heat rates. Each strip represents a definite combination of generating equipment, under specific conditions, at a station. Strips are plotted on a logarithmic scale so that station incremental heat rates may be used to compare incremental cost rates mechanically by means of a special frame device. This device contains a slot for each station into which the loading strips may be inserted. At the left is a scale of incremental heat rates.

In developing a suitable scale four factors must be considered: (1) range to be covered, (2) length of scale, (3) width of division, (4) the length and width of divisions of the dependent fuel-cost-adjustment scale. On the particular system for which this frame was built, station incremental heat rates ranged from about 9000 to 28,000 Btu per hr per kw, and a scale range from 8000 to 30,000 allowed for any reasonably anticipated expansion. To keep the strips from being awkward to handle, their length was limited to 36 inches.

A suitable scale was fitted in a 32 in. length without undue crowding of the divisions. Four inches were allowed for notations at the top of the strips. The scale can be split, if needed, allowing sufficient overlap of the sections to take care of the fuel-cost adjustment.

The incremental-heat-rate scale used

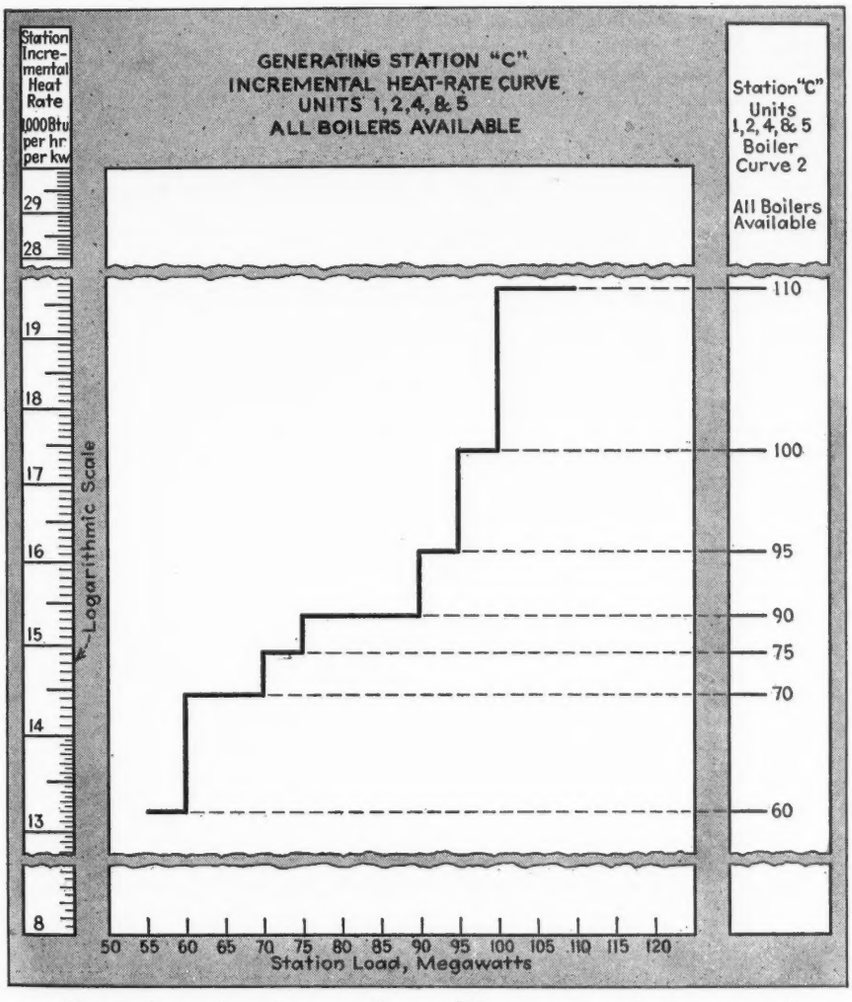


Fig. 2—For each station operating condition, a paper strip is constructed from a curve of incremental heat rates plotted to a logarithmic scale

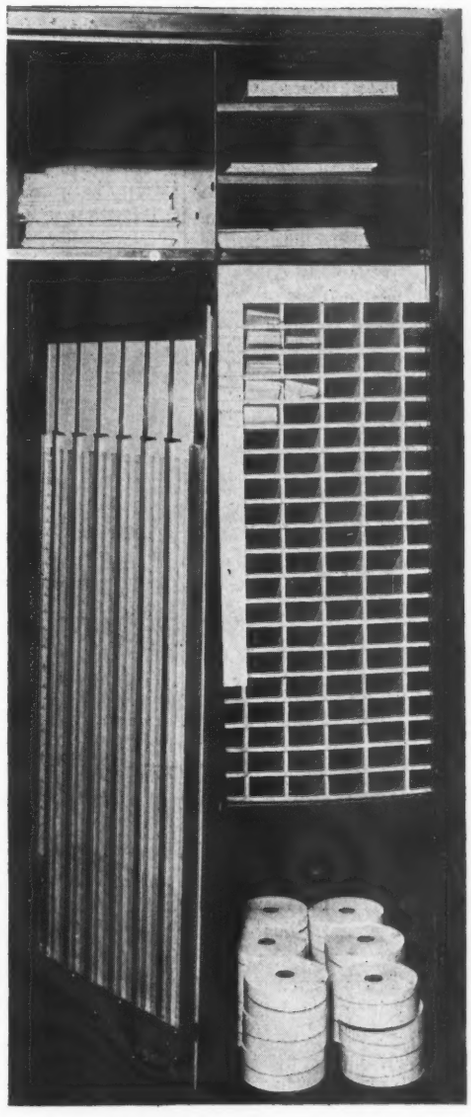


Fig. 3—Strips, paper, frame and finished schedules are all kept in a single compact cabinet

was prepared by taking the difference between logarithms of highest and lowest incremental heat rate on the scale:

$$\begin{aligned} \text{Log} \quad 30{,}000 &= 4.4771 \\ \text{Log} \quad 8{,}000 &= 3.9031 \\ \hline \text{Diff} \qquad\quad &= 0.5740 \end{aligned}$$

This logarithmic difference of 0.5740 is to be represented on a scale 32 in. long. A difference of 1.0000 in logarithms would be

$$\frac{32 \text{ in.}}{0.5740} = 55.75 \text{ in.}$$

The bottom of the scale represents 8000 Btu per hr per kw and any other incremental heat rate is located by multiplying the logarithmic unit division length of 55.75 in. by the difference between the logarithm of the

desired incremental-heat rate and the logarithm of 8000. This gives the number of inches from bottom of scale to lay off the desired incremental heat rate. Calculation is shown in Table I.

To develop a "loading" strip from this scale, a blank strip is placed alongside the scale with bottom registering. The bottom of the strip then represents 8000 Btu per hr per kw. Lines may then be marked on the strip at *incremental heat rates* corresponding to desired loads. The proper *loads* are printed adjacent to the marks. In cases where the incremental heat rate is constant it is only necessary to print the highest load obtainable at that incremental heat rate. For convenience the strips were made 2 in. wide. This allows sufficient room for marking loads and identification titles. Fig. 2 shows a loading strip and the incremental-heat-rate scale.

Making the Schedule

To make a loading schedule from these strips place them alongside one another, in proper combination, and in position to read directly the most economical division of load between stations. A relative-fuel-cost adjustment scale is provided at the bottom of each slot in the frame device developed on the same base as the incremental-heat-rate scale, established previously as 55.75 in., representing a difference of 1.0000 in logarithms. Since the bottom of the scale represents a ratio of 1.00 (logarithm 0.0000), to locate any other ratio multiply 55.75 in. by the logarithm of the desired ratio. This gives distance in inches from bottom of scale to lay off the desired ratio. On this system, the divergence of fuel cost between stations has never exceeded 10%. Therefore a scale covering each 0.01 to 1.10 ratio was developed, as shown in Table II.

Fig. 1 shows the frame device with scales in place. The strips are slid into slots in the frame until the bottom edge is set on the proper fuel-cost ratio. The incremental heat rate, corresponding to any load on the strip, is thereby automatically multiplied by the relative-fuel-cost ratio applicable.

To facilitate reading, a slide containing a horizontal cross hair is provided. To make a load schedule, the slide is placed at the bottom of the frame and all stations are given minimum load. Then load is picked up at the station where a strip marker first appears under the hair-line, as the slide is raised. That station is then brought up to the load indicated. The slide is raised until the next strip marker appears, and that station is given the indicated load. This is continued until all stations are loaded.

The typical loading schedule shown, Table III, is made from the strips appearing in the device. The cabinet has a nest of slots built in for convenient filing and storage of the strips.

Additional Features

By changes in design, many additional features could be incorporated. For example, strips with punched holes could be used with photoelectric cells to operate counters indicating station loadings and also total system load. As a further refinement the counters might be made recording and used to produce a printed load schedule directly. Where it is desirable to make load division a completely automatic function, the photoelectric-cell device could be constructed so that a system totalizing wattmeter would set the device to system demand. An indication of economical load could then be transmitted directly to each station.

While the device was primarily designed to produce load schedules, its field is not limited to this use. It can be used to indicate system incremental heat rate directly. By a simple change of scales, system incremental fuel cost can be indicated directly. This speeds up billing for power interchange on interconnected systems. The device may also be used in any field where many curves are compared frequently in different combinations.

With a nominal expenditure for material and labor the device has successfully solved the problem of producing load schedules rapidly enough to follow changing system conditions without the use of technically trained labor, and without increasing the cost of producing the schedules to a point inconsistent with the savings to be derived.

TABLE I. COMPUTATIONS FOR INCREMENT-RATE SCALE

A	*B*	*C*	*D*
Incremental Heat Rate Btu per hr per kw	*Log "A"*	*Log "A"— Log 8000*	*Inches from Bottom "C" x 55.75 Inches*
8,000	3.9031	0.0000	0.00
8,100	3.9085	0.0054	0.30
8,200	3.9138	0.0107	0.60
8,300	3.9191	0.0160	0.89
.....			
29,800	4.4742	0.5711	31.84
29,900	4.4757	0.5726	31.92
30,000	4.4771	0.5740	32.00

TABLE II. COMPUTATIONS FOR COAL-ADJUSTMENT SCALE

A	*B*	*C*
Fuel Cost Ratio	*Log "A"*	*Inches from Bottom of Scale "B" x 55.75 Inches*
1.00.....	0.0000	0.00
1.01.....	0.0043	0.24
1.02.....	0.0086	0.48
.....		
1.09.....	0.0374	2.09
1.10.....	0.0414	2.31

TABLE III. TYPICAL SYSTEM LOADING SCHEDULE

System Load Megawatts	*Station "C"–103* Units 1, 2, 4, 5*	*Station "A"–63 Units 3, 4*	*Station "B"–26 Units 1, 3, 5*	*Station "E"–88 Units 1, 2, 3, 5*	*Station "D"–48 Units 2, 3*	*System Load Megawatts*
400	60	60	80	125	75	400
425	60	60	90	125	90	425
450	60	60	90	140	100	450
475	60	70	95	140	110	475
500	60	75	105	150	110	500
525	60	75	115	150	125	525
550	65	90	120	150	125	550
575	70	90	125	165	125	575
600	75	90	135	165	135	600
625	85	90	140	175	135	625
650	90	105	140	175	140	650
675	95	110	150	180	140	675
700	95	110	150	200	145	700
725	100	110	150	215	150	725
750	110	110	160	220	150	750

* *Refers to strip number*

Ounces of Freeze Prevention

You can save yourself a lot of trouble and expense by putting this anti-freeze prevention program into effect before cold weather sets in

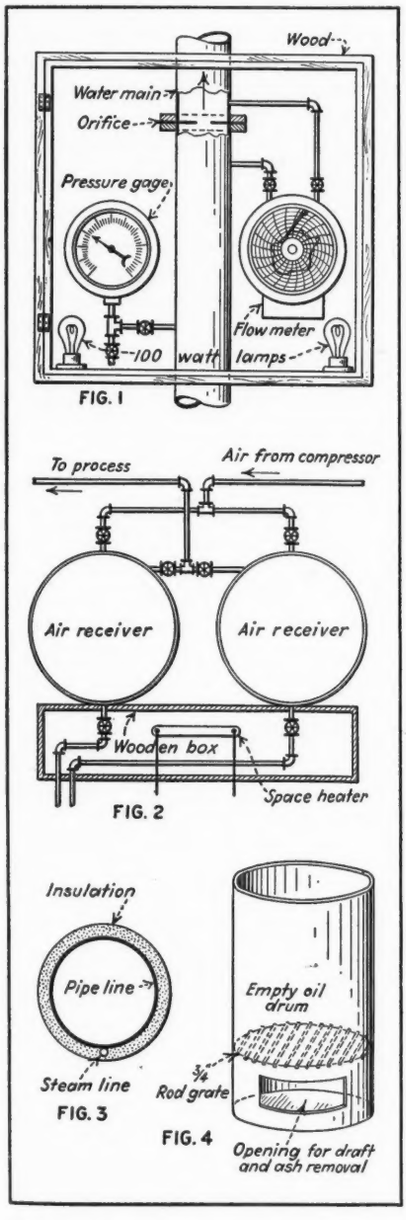


Fig. 1—Meter enclosure heated with lamps. Fig. 2—Pipe enclosure heated with strip heater. Fig. 3—Insulated pipe heated with steam. Fig. 4—Coke salamander, made from oil drum, for heating power-service equipment

THE FIRST STEP in an anti-freeze program for power-service equipment is a survey of all exposed piping and accessories to determine what items are subject to freezing. Maintenance records covering past winters will assist in making this segregation.

The table gives principal danger points and some of the methods of protecting against freezing. In order to make this table as complete as possible, plumbing and roof drainage, which usually are not considered power-service functions, have been included. It is well to remember, however, that where temporary heat is indicated, relative installation and operating costs of steam and electrical heat must be considered.

Needless to say, frequent inspection of all equipment subject to freezing is essential. If freezing does occur, it is much easier to thaw out local ice formations before they spread to other sections of the system. Blow torches are ideal for this purpose. Thawing pipe lines electrically with low-voltage high-current transformers or, in the case of small lines, with arc-welding motor-generator sets, will often save much time and trouble.

ANTI-FREEZE CHECK LIST FOR 13 TYPES OF EXPOSED POWER-SERVICE EQUIPMENT

Equipment	*Service*	*Operating Conditions*	*Method of Preventing Freezing*
Gages	Steam, water and air	In service	Enclose and provide heat, or use alcohol or other anti-freeze mixtures in gage lines.
		Inoperative	Remove and store in warm place.
Meters	Steam, water and air	In service	Enclose and provide heat as in Fig. 1.
		Inoperative	Drain and disconnect.
Piping	Steam	In service	Bleed all points in which water can collect.
Piping	Water and air	High flow	Insulation sometimes needed.
		Low flow	Insulate or provide steam-heating line, Fig. 3.
		No flow	Insulate, bleed or provide heat. Fig. 2 shows strip heater used to prevent freezing of air-receiver blowoff lines.
Piping	Steam, water and air.	Inoperative	Remove all plugs, open all valves and drain. Stop all leaks in the system. Be sure lines slope to drain without pockets or sags. Open all unions. Loosen valve bonnets. Where globe valves cause pockets, open line.
Traps	Steam and air	In service	Inspect frequently to insure against failure to operate and cooling below freezing.
		Inoperative	Drain and open unions.
Diaphragm or pilot-operated accessories.	Steam, water and air	In service	Enclose and provide heat. Use alcohol or other anti-freeze liquids in chambers and piping.
		Inoperative	Drain, loosen connections, and open diaphragm-chamber and valve-bonnet joints.
Tanks	Water	In service	Provide heat where flow is intermittent.
		Inoperative	Drain and leave all drain valves open.
Receivers	Air	In service	Blow down frequently to avoid water accumulation.
		Inoperative	Drain and leave all drain valves open.
Pumps	Water	Continuous operation.	Heating nor ordinarily required. Protect control piping against freezing.
		Intermittent operation.	Provide heat to prevent freezing during shutdowns. One large pump house is heated with a coke salamander, Fig. 4.
		Inoperative	Open all drain valves. Loosen packing gland or remove packing. Remove disks from check valves and guard against leakage. Open valve-bonnet joints and unions of sealing-water and drain lines.
Engines, turbines and compressors.	Steam and air	Continuous operation.	Provide heat to protect control appliances.
Compressors	.....	Inoperative	Open all drain valves. Loosen packing gland or remove packing. Break joints of all valves, cooling-water and control lines. Follow manufacturer's instructions for laying up the equipment.
Fire-protection piping.	Wet system	Continuous	Provide heat. Avoid localized cold areas, caused by broken windows or other sources of cold air.
Fire-protection piping.	Dry system	Continuous	Provide heat to protect water lines up to dry valve and air compressor. Drain system after every operation of dry valve. Bleed drips regularly.
Plumbing	.....	Continuous	Provide heat.
		Inoperative	Drain flush boxes and break water connections to them. Syphon out toilet-bowl traps and refill with alcohol or other anti-freeze solution. Syphon out all traps without drainage and fill with alcohol or other anti-freeze solution. Open all valves and loosen packing glands. Tie float-operated valves in open position.
Gutters	Water	Continuous	Keep free of ice dams with calcium chloride or by steam line installed for thawing.
Downspouts and leaders.	Water	Continuous	Enclose or provide steam line for thawing.

Why Auto-Transformers?

The answer is that, although their applications are limited, auto-transformers give real savings over 2-winding transformers for reduced-voltage starting of squirrel-cage and synchronous motors, changing voltage ratio on power circuits, etc

By J B GIBBS
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AUTO-TRANSFORMERS offer possibility of making certain changes in voltage or phase of ac circuits at a considerably lower cost than with standard 2-winding transformers, and with better efficiency. Applications are limited, but in these they permit real savings compared to 2-winding transformers. Among the more common uses for auto-transformers are reduced-voltage starting of squirrel-cage and synchronous motors and on power circuits where a voltage-ratio change is required. For example, power generated at Boulder Dam is received at Los Angeles and stepped down by banks of auto-transformers from 275,000 to 132,000 volts. These are the largest ever built. Each of the three in a bank is rated at 65,000 kva with air blast on the oil-cooling radiators. If 2-winding transformers had been used, only about half the power output could have been obtained with the same material in the transformers.

Operation

Auto-transformers may be regarded as a special type, in which the primary and secondary currents use a part of the winding in common. Consider the transformer with a 1-to-1 ratio in Fig. 1. It has a high-voltage rating of 115 volts, 10 amp, with an equal low-voltage rating, and delivers 10 amp at 115 volts to the load, or 1150 watts. Now, connect H_2 and X_1 terminals together, and the load to X_2 and H_1, Fig. 2. With the same currents in the windings as before, the transformer will deliver to the load 10 amp at 230 volts, or 2300 watts. This is the principle of the auto-transformer, and the example shows that for a 1-to-2 ratio, the auto-transformer can deliver twice as much power as a 2-winding design of the same size.

If a 2-winding transformer designed to transform from 10 amp, 115 volts to 20 amp, 57.5 volts, 1150-watts capacity, is connected as an auto-transformer, Fig. 3, the power delivered to the load will be 20 amp at 172.5 volts, 3450 watts, or 3 times the power delivered by the 2-winding transformer.

Why this is true is evident from Fig. 3. Line volts at the instant shown are applied from H_1 to H_2 terminals of the primary winding, which causes a current to flow in direction of the arrow. Winding ratio being 2 to 1, 57.5 volts are induced in the secondary winding, which is so connected to the primary that line and secondary volts add together to give 172.5 volts. This is evident by following from H_1 to X_2 through the secondary winding to X_1 and H_2.

The economic advantage of the auto-transformer depends on the ratio of transformation. The nearer the input and the output voltages come to being the same, the greater the saving, as compared with a 2-winding transformer.

As the voltage ratio increases, advantage of the auto-transformer over the 2-winding design grows less, and the former is rarely made with ratio greater than 4 or 5 to 1. Another reason for this is that, in an auto-transformer, high- and low-voltage windings are electrically connected; consequently, both require equal insulation to ground. This adds considerably to the cost of auto-transformers for high-voltage ratios, making it more economical to use 2-winding transformers for such applications.

Not only the size of parts but also the losses in an auto-tranformer are less than those of a corresponding 2-winding transformer. For a given amount of material in core and coils, losses will be nearly the same, no matter whether the material is made into a 2-winding or an auto-transformer. The higher output of the latter then results in improved efficiency and regulation.

Auto-transformers are often used to establish the neutral point of a circuit, and to change the voltage. For example, an electrified railroad transmits single-phase power at 22,000 volts and uses 11,000 volts on the trolley. An auto-transformer is connected across the 22,000 volt line and its middle point is grounded to the rail circuit, Fig. 4. This insures that the voltage from either side of the 22,000 volt circuit to ground will be maintained at 11,000 volts. The two sides of the line are used to feed alternate sections of the trolley, as in the figure, and thus the advantage of 11,000-volt utilization is gained, with the economy of 22,000-volt transmission.

Polyphase Connections

Auto-transformers are also used on polyphase as well as single-phase circuits, some of the commonly used connections being shown in Figs. 5 to 10. Fig. 5 shows three single-phase auto-transformers connected in star to decrease the voltage of a 3-phase circuit. If the tap is in the middle of each auto-transformer, voltage on the low-voltage side will be one half that on the high-voltage side. With a balanced 3-phase load, each auto-transformer operates as though it were on a single-phase circuit, and the total kva rating is the same as the kva output.

The connection arrangement, Fig. 5, does not permit the triple-frequency component of exciting current to flow in the auto-transformers, and therefore causes voltage distortion, unless the amount of power is small. If star-connected auto-transformers are to handle large amounts of power, each auto-transformer will have an auxiliary winding. The three auxiliary windings are then connected in delta to provide a path for the flow of the triple harmonic part of the exciting current.

Open-delta or vee connection of two auto-transformers to reduce voltage of a 3-phase line is shown in Fig. 6. This

connection is sometimes convenient for small amounts of power because only two auto-transformers are used, instead of three. On account of phase difference between the voltage and current in a vee connection, however, a greater total size of parts is required than with the three auto-transformers, Fig. 5.

Fig. 7 shows the tee connection sometimes used for 3-phase to 3-phase transformation. This connection takes slightly smaller total parts than the open-delta connection. The two auto-transformers are not duplicates, however, and the open-delta is often preferred.

The well-known Scott connection is probably more used than any other auto-transformer connection for 3- to 2-phase transformation. Fig. 8 shows the usual arrangement. One end of the circuit *A-B* on the 2-phase side is connected to the middle of the circuit *C-D*. This connection is suitable for 2-phase motors whose two circuits are insulated from each other, but not for motors with interconnected windings. For the latter, the connection Fig. 9 may be used. The teaser winding *A-B* is extended past the junction with the middle point of the main winding *C-D* to make this the common neutral of the two circuits. The teaser will then require larger parts than with the arrangement, Fig. 8, but the 2-phase line may be used with either type of 2-phase motor.

Synchronous Converters

Sometimes 6-phase, synchronous converters are operated from 3-phase lines by means of auto-transformers, Fig. 10. The three auto-transformers are connected in star and each has an extended winding so that the common point of the three auto-transformers is also the neutral of the synchronous converter. In this connection, the extended windings of the auto-transformers, together with the windings of the machine, form a path for the third harmonic part of the exciting current. The voltage, therefore, is not distorted from this cause as it is in the star-connected 3-phase to 3-phase transformation, Fig. 5. With the connection, Fig. 10, the synchronous converter may be connected to a 3-wire dc system, the middle or neutral dc line being connected to the common point of the auto-transformers.

Auto-transformers can be used to advantage in many single-phase and polyphase circuits. Where they are suitable, their use is economical both in cost and in losses. They are not suitable for large ratios of transformation, and care must be taken to avoid trouble from primary and secondary circuits being electrically connected.

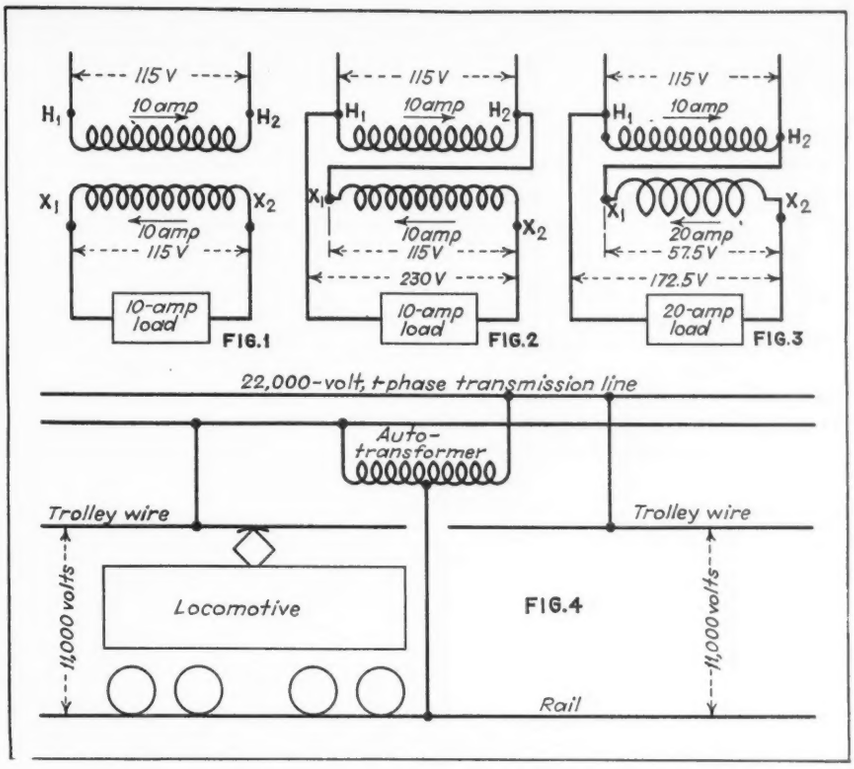

Fig. 1—Two-winding transformers. Fig. 2—Transformer, Fig. 1, connected for an auto-transformer with voltage ratio of 1 to 2. Fig. 3—Auto-transformer having voltage ratio of 1 to 3. Fig. 4—Auto-transformer applied to obtain 11,000 volts from 22,000-volt line

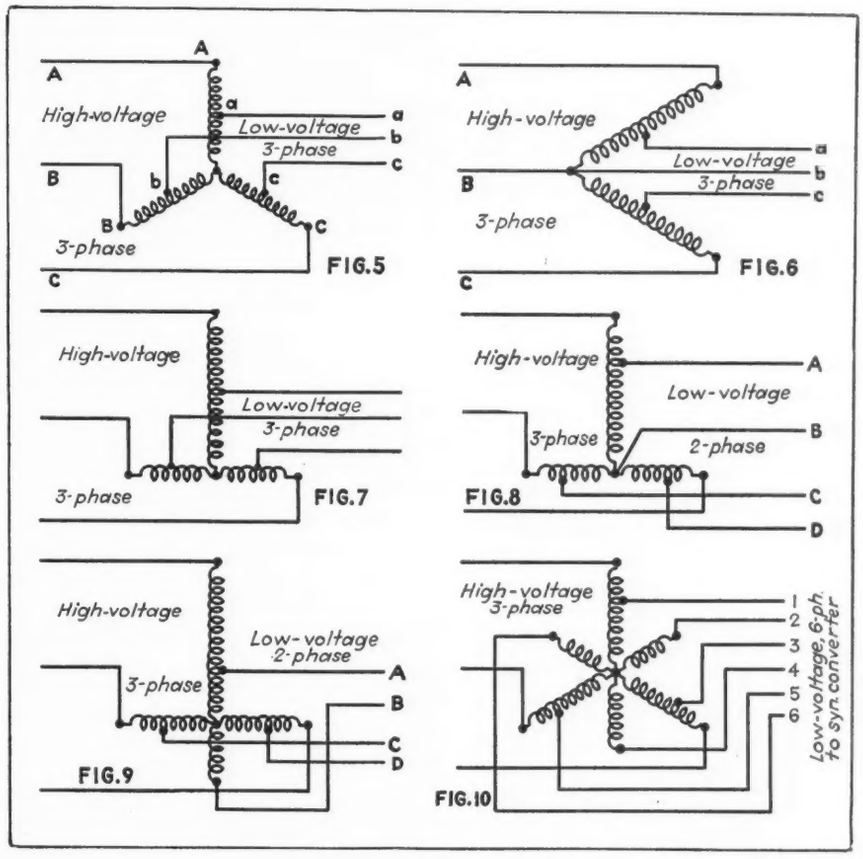

Fig. 5—Three auto-transformers star-connected on a 3-phase circuit. Fig. 6—Two auto-transformers connected open-delta on a 3-phase circuit. Fig. 7—Two auto-transformers connected tee for 3-phase transformation. Fig. 8—Two auto-transformers Scott-connected for 3- to 2-phase transformation. Fig. 9—Modified Scott-connection of two auto-transformers for 3- to 2-phase transformation. Fig. 10—Three auto-transformers connected to change 3-phase current to 6-phase

Power for Transit

High-pressure top at Williamsburg, supplying 25-cycle power to Brooklyn's subways, surface and elevated lines, solves problem of high land cost by building vertically. Design reflects influence of kind of fuel available and its cost, operating load factor, quantity and quality of condenser-water supply, and coal storage

By A C KLEIN
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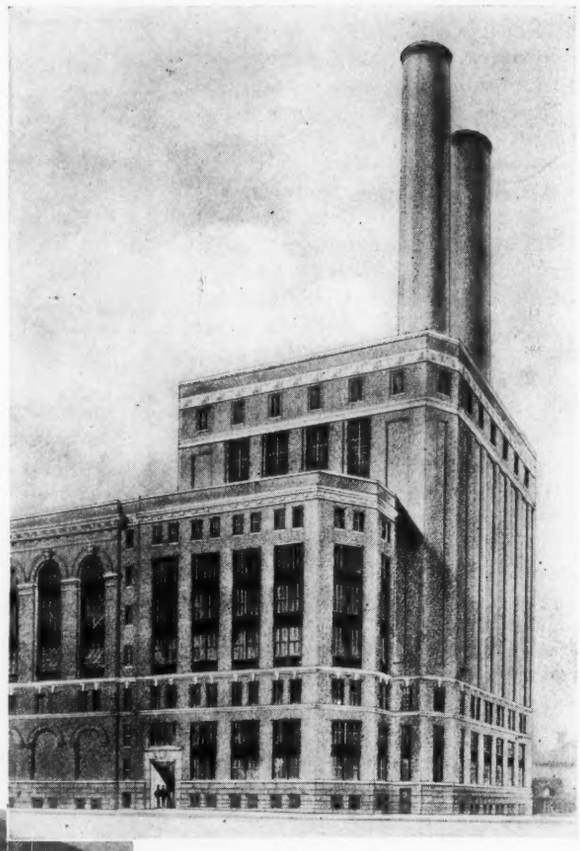


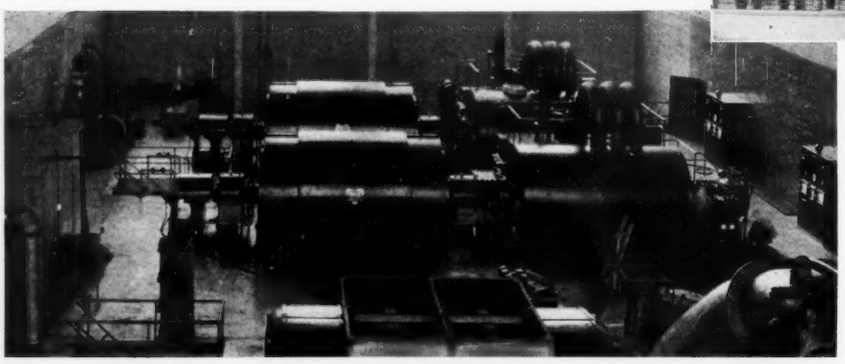


Fig. 1—Two 1500-rpm Allis-Chalmers turbines drive 18,750-kva generators and exhaust 200-lb steam enough to operate two older 35,000-kva units at full load

FOR OVER thirty years the Williamsburg Power Plant has been the principal source of electric energy for the transit lines now operated by the Brooklyn-Manhattan Transit Corporation and its subsidiaries. The station was constructed in 1904—1906 and since then has supplied electric power continuously, first for the surface and elevated lines of Brooklyn, and later to the Company's subway system in Brooklyn.

The plant contained seventy-two 6000-sq-ft boilers fired by underfeed stokers and generating steam at 200 lb pressure and 100 F superheat. The boilers supplied steam to eleven turbine-generators having a total capacity of 182,500 kw. It had no outside coal storage, coal being received in barges as required, unloaded, crushed and stored in large overhead bunkers which contained enough coal when full to operate the plant for about ten days.

In the spring of 1936, the Williamsburgh Power Plant Corporation engaged Stone & Webster Engineering Corporation to make a survey of its power-generating facilities and to recommend the best method of extending the Williamsburg Station. The conclusion reached was that the plant should be extended by the installation of two superposed turbine-generators of 18,750 kva each, supplied with steam from two 850-lb, 830-F boilers, and exhausting into the existing 200-lb steam mains. The plant described in this article is the result of the acceptance of those recommendations.

As in any plant, certain important factors have been given predominant weight in the design of the plant extension. Coal is available from a number of fields and the plant design has, therefore, been adapted to take advantage of a wide range in fuel quality. A plentiful supply of condensing water is available, but the presence in it of a substantial amount of sewage has made condenser leakage a serious problem.

In common with other parts of the New York Metropolitan area, a very limited amount of land was available and this made it impossible to provide coal-storage facilities comparable with those of power plants constructed in less congested areas. High land cost also has dictated a design whereby equipment was arranged vertically rather than spread out over a considerable area. Another important factor is that the Williamsburg power system is essentially self-contained, operating at 25 cycles and having no major interconnections with any adjacent power system. This last factor dictated that reliability of operation must take precedence to a far great degree than is the case with power plants having reliable major interconnections that may be called on in emergencies.

Power-Plant Buildings

Fig. 2 shows the location of the existing and new construction. The new boiler room has been located adjacent to and north of the Annex turbine room. It is approximately 100 ft wide, 110 ft long, and 160 ft high. The

superstructure consists of a structural steel frame with exterior walls of brick with granite facing and caststone trim, to harmonize with the existing buildings. Its most unusual feature is the 5000-ton steel-plate coal bunkers which have been built as an integral part of the building-steel framework.

In order to obtain sufficient width for the boilers and their coal bunkers, it was necessary to locate the first boiler a considerable distance to the west of Kent Avenue. The space thereby made available has been utilized for the erection of a 7-story service bay, the construction of which is similar to the new boiler house. This service building will contain locker rooms for all plant employees, offices for the supervisory force, storerooms for light and heavy plant supplies, and a floor for the laboratory.

Space was available in the Annex turbine room for the installation of the two new turbine-generators and their auxiliary equipment. Their installation, however, encroached on the dismantling space, so the turbine room was extended 28 ft to restore the dismantling space so appropriated.

extended to form the basement level of the boiler room. On that level are located pulverizers, ash sluices, high-pressure boiler-feed pumps, and heater-drip pumps. The existing turbine-room operating level has also been continued to form the operating floor for the new turbines and boilers. An intermediate level was selected for a mezzanine floor on which are located deaerators, air and oil coolers, the station service switchboard, pulverizer feeders, and the new high- and low-pressure feedwater heaters.

Walkways

Above the boilers a grating and concrete floor has been provided for access to preheaters, fan-control equipment and the transformers and rectifiers of the ash precipitators. Above this grade, a series of walkways and platforms give access to the precipitator hoppers and to the dust-unloading equipment which serves them. The highest operating grade, 138.50, forms the roof of the boiler room proper, the floor of the fan room, and the walkways above the coal-storage bunker.

Special attention has been given to natural lighting and to ventilation. Three large skylights, with ridge-type ventilators, have been installed in the boiler-room roof, and rows of ventilating sash have been provided in the east, west, and north walls of the building. The west wall, the east wall above the roof of the service bay, and the north wall below the coal bunkers are largely composed of glazed sash. In addition, the air supply for the forced-draft fans can be taken from the boiler room beneath them through grating floors, or from outdoors.

Boiler Plant

The boiler plant consists of two 575,000-lb-per-hr water-tube boilers designed for 850-lb pressure, 830-F temperature. The boilers are of the single-pass type with economizers and superheaters located above the steam-generating tubes. The flow of gas through the economizer and superheater sections is in parallel and is controlled by dampers automatically operated to maintain the steam temperature at 830 F at all loads from full load to half load.

Each boiler is equipped with a water-wall furnace, divided into two parts by a slag screen connected to the

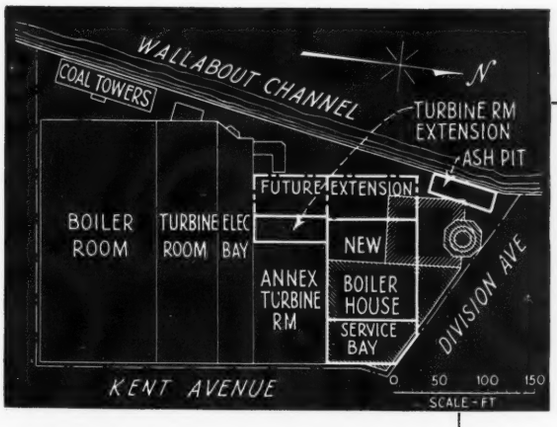


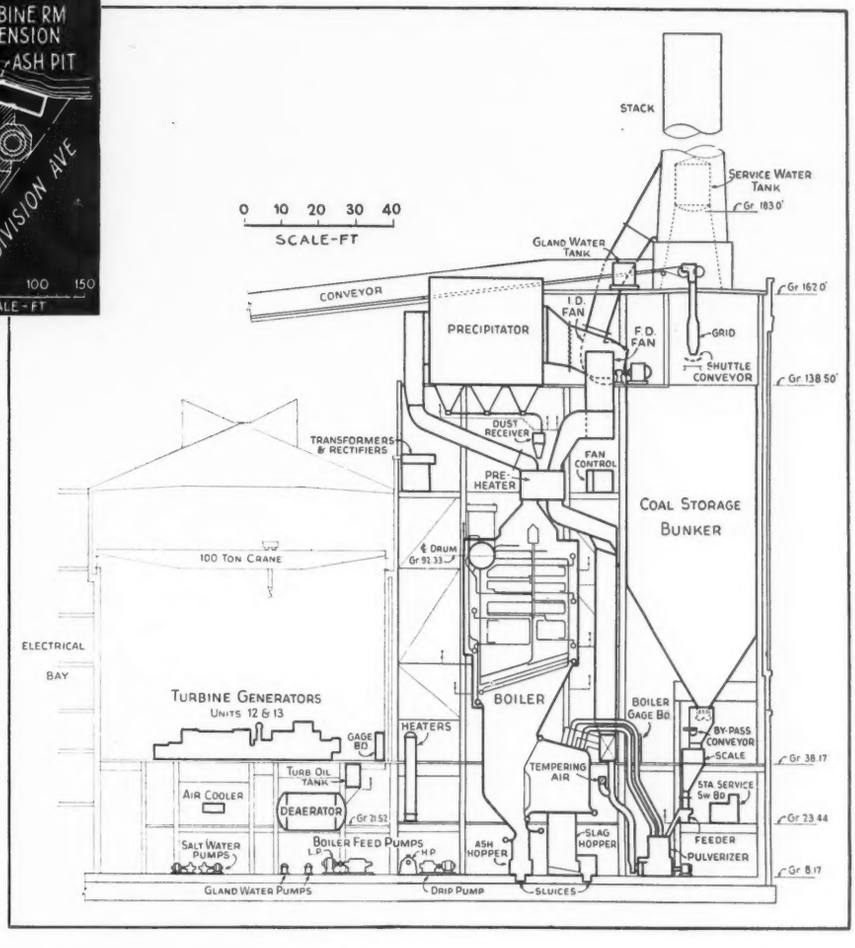
Fig. 3—Cross section indicates how limited ground area influenced design, resulting in vertical arrangement of equipment

The exterior view of the new service bay and of the boiler house shows part of the Annex turbine room at the left. Architecturally, this view is interesting because of the treatment used to obtain a pleasing continuation of the old elevation. Also of interest are the great height of bare wall on the north wall of the boiler house, and the method of relieving it with vertical brick panels. This wall emphasizes the great height of the coal bunker.

Equipment Arrangement

The arrangement of the major pieces of plant equipment is shown by Figs. 3 and 4. The condenser floor has been

Fig. 2—Plant extension occupies nearly all available space on high-cost waterfront property alongside historic 200-lb station



boiler-circulating system. The primary section is fired by six intertube pulverized-fuel burners and is equipped with an ash hopper into which molten slag from the furnace flows continuously. The secondary furnace is also water-cooled and is equipped with an ash hopper to store dry ash. A complete complement of soot blowers has been installed, including retractable type elements, in the walls of the secondary furnace for removing ash from them and from the rear slope of the dry-ash hopper.

The six burners of each boiler are supplied with pulverized fuel by three motor-driven, double-roll ball mills equipped with automatic coal feeders. The mill capacities are such that two of them will operate the boiler at 80% of its maximum capacity. Hot- and cold-air connections are provided to facilitate pulverization of coal of varying moisture content. Burner ignition is with illuminating gas obtained from the local city-gas system with automatic electric ignition.

Draft System

Above each boiler, two 24,500-sq-ft air preheaters have been installed. These receive flue gas from the economizer and superheater sections of the boiler. From the outlet of the preheaters, gas is passed through electrostatic ash precipitators for the removal of their flyash. The precipitators have been erected on the boiler-room roof, but their hoppers extend through the roof into the building below. The hoppers are equipped with vibrators and with pneumatic conveying equipment to facilitate the removal of the flyash. From the outlet of each precipitator, the flue gas is delivered by an induced-draft fan to a superposed radial-brick stack 13 ft diameter and 114 ft high. Each boiler is also equipped with one forced-draft fan delivering air to the inlet of the air heaters. From the outlet of the air heaters, two ducts convey the air for each furnace to the burner plenum chamber.

The forced- and induced-draft fans are driven by variable-speed induction motors, speed of which is regulated by the combustion-control system, supplemented by intermediate damper control.

Coal-Handling System

The existing coal-handling system includes a cable road at the top of the present boiler house, which has been utilized by installing a receiving hopper beneath the cableway into which the coal is discharged for transmission to the new coal bunkers. From this point a 30-in. belt conveyor, rated at 250 tons per hour, is carried in a gallery across the roofs of the existing buildings to the top of the new coal bunkers. The conveyor is equipped with a magnetic pulley for the removal of tramp iron at its head end. From the belt discharge point, coal passes over bar screens to remove debris, onto a shuttle conveyor which distributes it to either storage bunker.

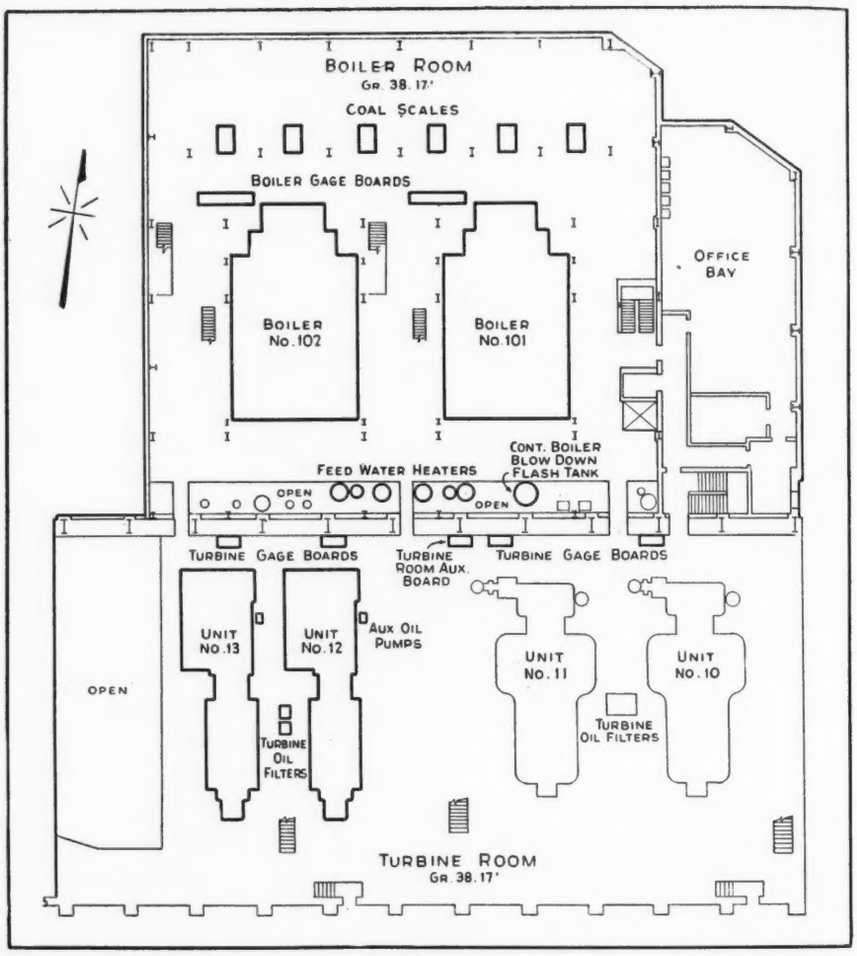


Fig. 4—In normal operation, each boiler supplies one high- and one low-pressure turbine, in effect, two separate plants. Steam and feedwater connections permit any combination of equipment in event of outage

Each coal bunker has three discharge hoppers, from each of which coal flows through a coal scale to a 5-ton hopper which supplies the pulverizer feeder. In order to permit the maximum amount of flexibility in utilizing the coal bunkers, a reversible screw conveyor has been installed through the six hoppers of the two main fuel bunkers. This conveyor can draw coal from any of the six bunker hoppers and deliver it to the pulverizers normally fed by the other bunker. While the conveyor will not be used normally, it will make the full 5000-ton storage continue to be available when either boiler is out of service, and it will also enable both boilers to be operated from either bunker when the other one is out of service.

The turbine installation consists of two 1500-rpm reaction-type turbines, each driving an 18,750-kva, 3-phase, 25-cycle, 11,000-volt generator. The load consists largely of synchronous converters so that the power factor can be maintained close to unity. It is therefore expected that 18,750 kw will be obtained from each turbine. Each turbine will exhaust enough steam to supply one of the existing 35,000-kw, 200-lb turbine-generators and its auxiliaries and to heat feedwater to 380 F.

The piping systems have been arranged so that either 35,000-kw unit may be shut down, and a 30,000-kw unit in the older part of the plant operated with one of the topping units. A reducing valve and desuperheater of the capacity of one boiler have been provided so that both boilers may continue in operation when a superposed turbine is out of service.

Because of the poor quality of the condensing water, special precautions have been taken to obviate taking boilers or turbines out of service in case of condensate contamination.

For the high-pressure boilers, the requirements for condensate purity are more exacting than formerly, and consideration has also been given to handling condensate which is satisfactory for the low-pressure boilers, but not for the high-pressure ones. This is accomplished by delivering slightly contaminated condensate to the old boilers and replacing it with uncontaminated condensate from the old plant. Condensate that is too highly contaminated for the old boilers must be dumped overboard, and for that emergency, a 1,000,000-lb tower-type condensate storage tank has been installed. This tank will permit two hours' full-load operation of one boiler and of one high-pressure and one low-pressure turbine, or sufficient to hold these units in service over the station peak load.

Other features of design introduced by the severe condensing-water conditions are generous sized air and oil coolers, the use of aluminum-bronze tubes in these coolers, and the installation of a rotary-type filter with a continuous automatic backwashing attachment to clean the water supply of the oil and air coolers.

Ash-Collection System

Ash is accumulated at three points for each boiler unit. The primary furnace produces molten slag which is quenched and collected in a wet hopper. The secondary furnace has a dry hopper which receives ash from its four furnace walls and from the lower generating tubes. A third source of ash is from the hoppers of the flyash precipitators.

In common with most New York river-front plants, the disposal of ash must be accomplished by loading it on barges which are towed to sea and dumped. To prevent the pollution of the river with ash-laden water, a recirculating system for ash-sulicing water has been installed. Storage for ash and provision for separating it from the sluicing water has been obtained by installing a large concrete ash-storage pit having its outer edge on the wharf line. This pit will store about 500 tons of ash, or enough for ten days' normal operation of the plant. At one end, a clear well and pump house have been provided with two 1100-gpm pumps. Either pump can move ash simultaneously from one boiler hopper and from the flyash system. The pit has been provided with a skimming wall so that maximum separation of ash is accomplished before the water is returned to the pumps. The pit is spanned by a revolving-type crane for loading ashes into barges.

Pumps

The largest pumps in the new plant are the high-pressure boiler-feed pumps. There are three of these, each designed to pump 625,000 lb of 380-F water per hour from a suction pressure of 225 lb to a discharge pressure of 1200 lb. They are driven by high efficiency 200-lb multivalve turbines that exhaust into 30-lb heaters. The plant also includes three motor-driven drip pumps, each rated at 100,000 lb per hour, and pumps for salt water, gland cooling, condensate makeup and combustion-control service.

Heat Balance

The station heat balance is illustrated by Fig. 5 for one high-pressure and one low-pressure turbine, utilizing the output of one high-pressure boiler. 108,000 kw will be generated by full-load operation of the topping plant and of its associated low-pressure turbines.

The heat balance has been built up from the existing feedwater heating facilities. These comprised an open-type feedwater heater, using steam from the turbine auxiliaries and from the low-pressure boiler-feed-pump turbines. As a first step to increasing the feedwater temperature to the new boilers, the open feedwater heater was replaced by two modern deaerating-type heaters. 200-lb heaters were next installed, taking their steam supply from the high-pressure turbine exhaust.

Turbine-Driven Pumps

Further study of the feed-heating cycle showed that it would be possible to drive the new high-pressure boiler-feed pumps by high-efficiency turbines, and to use their exhaust steam in 30-lb heaters between the deaerators and the high-pressure heaters. A further refinement is introduced by the installation of a drip cooler between the 30-lb heater and the 200-lb heater and by pumping the condensate of the 200-lb and 30-lb heaters into the condensate system at the inlet of the drip cooler.

At high loads there is a balance between the 200-lb steam required to drive auxiliaries and to heat feedwater. At low loads, there will be an excess of exhaust steam and at such times, motor-driven auxiliaries are available to restore the heat balance.

Instruments

Instruments have been concentrated on operating gage boards adjacent to each boiler, on fuel-control boards on the boiler-room mezzanine floor and on turbine gage boards adjacent to each turbine. Smaller gage boards have also been provided adjacent to the boiler-feed pumps. On these boards are mounted instruments indicating and recording all important pressures and temperatures, push buttons for hand operation of important auxiliaries, and an alarm system by which the attention of the operator can be called to any dangerous condition which may arise in the plant.

The plant extension was designed and constructed by Stone & Webster Engineering Corporation under the supervision of Mr C E Roehl, Electrical Engineer, Mr H A Robbins, Superintendent of Power, and of his immediate assistants, Mr R B Arthur and Mr H E Stoeltzing of the Williamsburgh Power Plant Corporation.

Other photographs showing the firing-aisle, ash-removal equipment and boiler-feed pump will be found on page 81 of this issue.

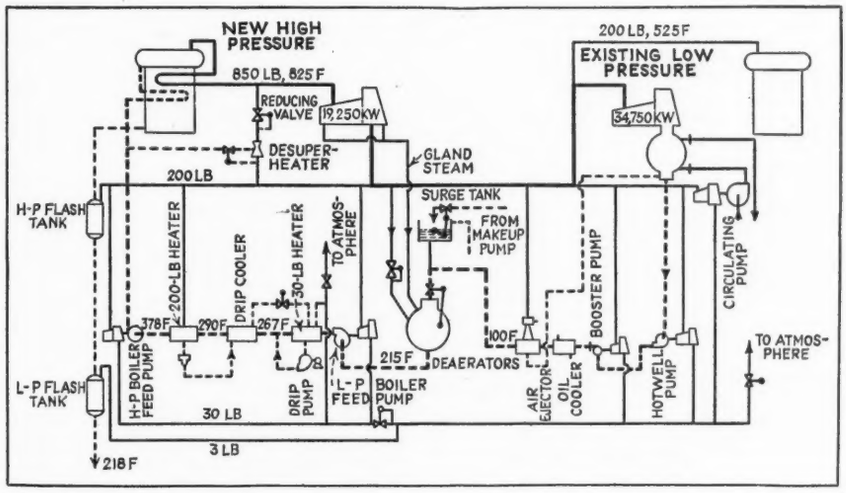


Fig. 5—Modern deaerating heaters, crossover heater and steam-driven boiler-feed pump are features of heat balance superposed on old station

Installing Single-Retort Stokers

More pointers on fitting stokers to load requirements and setting them in furnaces—with particular reference to ram-feed units. Fourth of a series on modern stokers

By L N ROWLEY
Assistant Editor

IN THE OCTOBER article, importance of matching stoker capacity to load was emphasized, and factors affecting both were discussed. With the exception of minor differences to be covered here, general principles given in that article apply equally to screw-feed and ram-feed stokers. However, the fact that drive and draft arrangements for ram-feed stokers are quite flexible makes the number of possible installation layouts much greater, and makes it advisable to devote more space to this phase.

Let's start by summarizing the situation on load and capacity. Determine maximum load by any one of means suggested in preceding article and express in Btu per hr. Convert Btu per hr to lb of coal per hr by dividing by heating value of coal to be burned and by combined efficiency of boiler and stoker. Remember that it is wise to use heating value of poorest coal likely to be used, and that heating value should be on an "as fired" basis. Combined efficiency may be taken as 65-70%, with the lower figure recommended as more conservative.

Ram-Feed Stokers

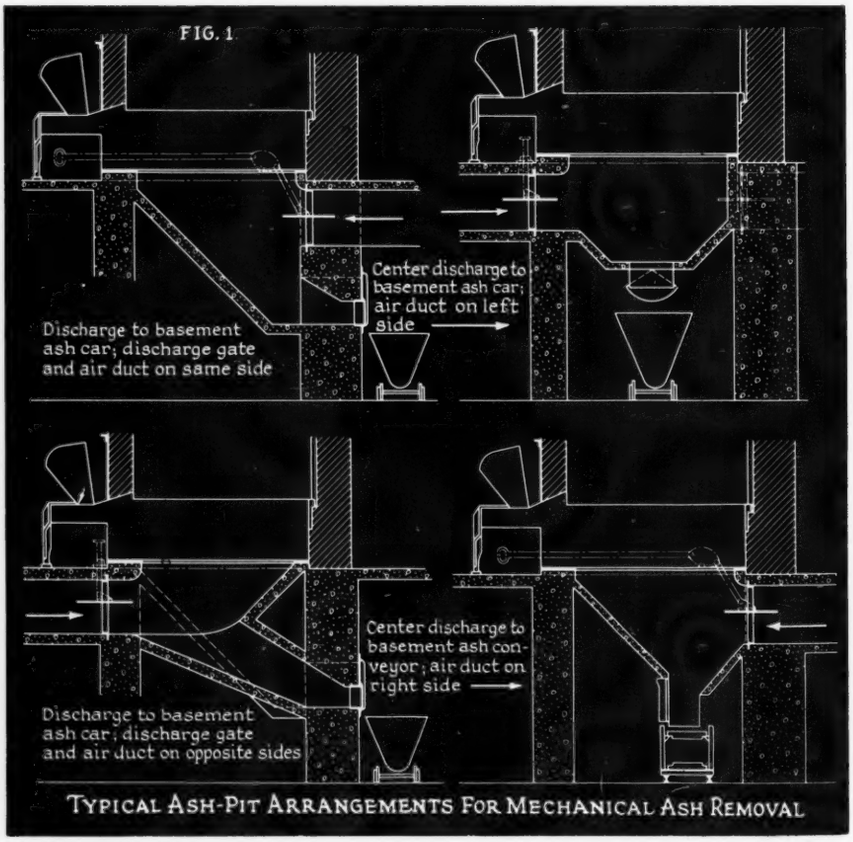
Some ram-feed stokers are rated directly in boiler horsepower or square feet of equivalent radiation, and for these the above procedure is unnecessary. It is important, though, to check basis for these ratings to see that it agrees with conditions to be encountered on the particular job. This caution applies especially to kind of coal—heating value of coal used to determine rating should agree with heating value of coal to be used in the plant, or a correction should be made to account for the difference.

Most ram-feed stokers are rated in terms of coal-burning capacity. This may be expressed as lb of coal stoker will burn in an hour, or a figure given for rate of burning on a square foot of grate surface. In either case, it is customary to give a continuous rating, and a maximum rating to be sustained 2–4 hrs. Where load is fairly regular and can be predicted with some accuracy, it may be desirable to select a stoker with a normal rating large enough to carry most loads, and to carry peak loads on the overload capacity of the stoker. Where loading is highly variable, and cannot be predicted closely, best bet is to select stoker with normal capacity sufficient to handle expected peak loads. This will keep overload capacity of stoker available for unexpected peaks, emergencies, or load growth.

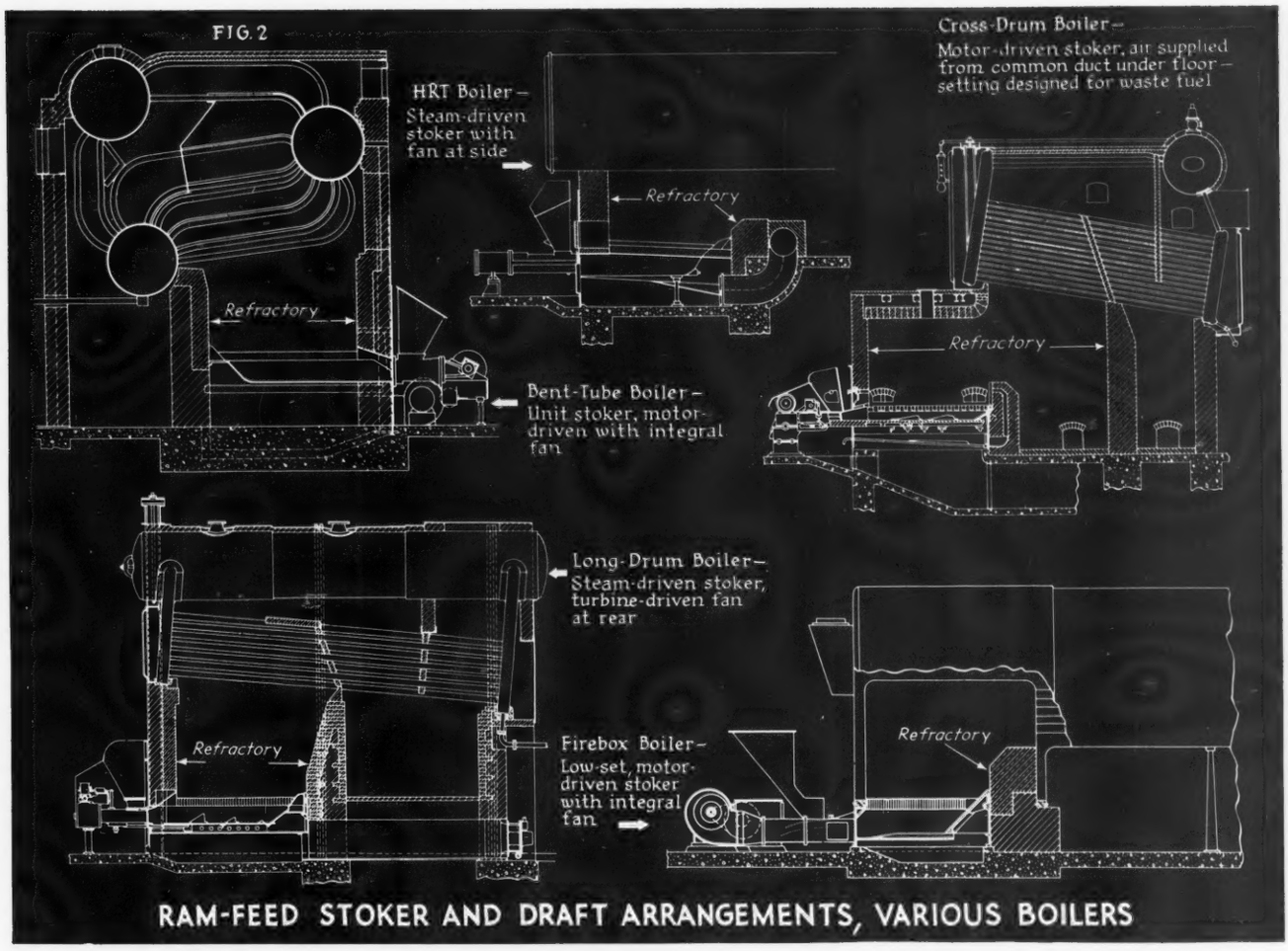
With coal-burning capacity of stoker settled, furnace dimenions govern choice of actual stoker. Fitting stoker in furnace is rarely a problem with screw-feed units, particularly in smaller sizes, but furnace dimensions must be considered with ram-feed units. Usual procedure is to select a stoker width to match furnace width. Stoker length will be fixed by grate surface required.

Combustion volume and setting height are of vital importance. Limit of 50,000 Btu per cu ft of furnace volume applies to ram-feed units as well as screw-feed, with some manufacturers suggesting lower heat releases as being more satisfactory. Setting height is practically impossible to specify, depending as it does on many

FIG. 1


Discharge to basement ash car; discharge gate and air duct on same side
Center discharge to basement ash car; air duct on left side
Discharge to basement ash car; discharge gate and air duct on opposite sides
Center discharge to basement ash conveyor; air duct on right side

TYPICAL ASH-PIT ARRANGEMENTS FOR MECHANICAL ASH REMOVAL



RAM-FEED STOKER AND DRAFT ARRANGEMENTS, VARIOUS BOILERS

factors. Most manufacturers will specify minimum and desired setting heights for any given installation.

Coal- and ash-handling layout desired, draft arrangement necessary, type of drive selected for stoker and fan, and design of boiler and furnace all affect installation of a stoker in any given case. While innummerable arrangements are possible, a much smaller number are encountered frequently, and attention will be centered on these.

Where there is no basement under boiler-room floor, it is customary to pull ashes from pits to floor by hand, taking them out at front or back as most convenient. Spray from sprinkler pipes in the pits quenches ash before removal. Since frequent dumping is unnecessary and removal of ash is quickly accomplished, this method is usually entirely satisfactory.

Ash-Pit Arrangements

With a basement, numerous ash-pit arrangements may be devised to carry refuse to removal equipment, such as car or conveyor. Fig. 1 shows some typical layouts. Elaborate equipment for mechanical ash removal is not usually justified in small plants, but where large quantities of coal are burned, or other considerations dictate it, mechanical removal offers advantages of ease and cleanliness.

Motor-driven ram-feed stokers, with integral fans, are simple to install, and typical layouts closely resemble those for screw-feed units. Stokers with separate fans may be installed in a wide variety of arrangements, some of which are illustrated in Fig. 2. With a fan to each boiler, location may be front, rear or side. With several boilers in a row, a common duct, preferably under the floor, gives a convenient and neat layout. Dampers at each boiler regulate flow to individual stokers; general control of air flow is usually by change in fan speed.

With boilers in a row, stokers are frequently driven from a lineshaft. Where possible, best layout is with shaft in trench with steel coverplates for access. Driving unit may be a motor, steam engine or turbine, and drive unit may be belted or geared to shaft for required speed reduction. Engines, because of simple speed control available, are particularly suited to this service, and a common arrangement features normal drive through belting from an engine, with an auxiliary motor. Auxiliary driver may be connected to shaft by manually operated clutch or with an overriding clutch so auxiliary can take over without stopping shaft. Great flexibility is possible with stokers having steam-piston or hydraulic drives.

Ram-feed stokers applied to common types of boilers are shown in Fig. 2. Of special interest is the setting for the cross-drum boiler, which is arranged for burning waste fuel, as well as coal. Wood refuse is dropped on grates through opening in roof of Dutch oven. Primary combustion in Dutch oven forms gases which are burned in furnace proper. Also of interest is the stoker applied to the firebox boiler. This unit is of special low-set design to avoid necessity of placing stoker in a pit.

Correction

In the October article "Installing Single-Retort Stokers", the following statement was made—"Dividing load in Btu per hr by the Btu of the coal would give the amount of coal the stoker must burn in an hour, if boiler and stoker were 100% efficient. But they're not, so it's necessary to *multiply* by expected efficiency." Of course, the last sentence should have read—"But they're not, so it's necessary to *divide* by expected efficiency."

Crack Detective

Although fatigue cracks in turbine blades are practically invisible, magnetic inspection has proved itself over several years an invaluable aid in preventing blade wrecks. Experience record describes results and applications of the Magnaflux process

By T C RATHBONE
Chief Engineer Turbine Division
Fidelity & Casualty Co of New York

COSTLY turbine wrecks occur when blade cracks progress to failure. Various methods have been used in attempting to discover cracks in their early stages. Turbines have thousands of blades, making the "whiting" test tedious and unsatisfactory. Detection of cracks by change in vibration frequency also has proved unreliable, due to differences between blades and buckets occasioned by non-uniformity in root fastening, section and shrouding. Also, for this method, cracks have to be developed to the extent of appreciably changing the section modulus of the blade.

Detecting cracks by change in the sound or "ring" when the blade or other part is struck a blow is not reliable. Broken lashing wires can be readily found in this manner, and occasionally well-developed cracks. But incipient cracks do not alter the tone sufficiently for detection. In one case, a disk wheel with a crack extending nine inches from the rim gave a clearer tone than other flawless disks.

Visual inspection, even with suitable lights, mirrors and careful cleaning of all surfaces, can not be depended upon. Some attempts have been made to heat the blades moderately with a torch, watching for an abrupt change in the characteristic oxide colors at a crack. Pickling to etch the crack is obviously to be discouraged. Of course, magnetic test methods are not applicable to non-ferrous blading. However, steel-alloy blades have become so prevalent that magnetic testing for cracks is widely used.

One magnetic method (the Magnaflux process) depends for its effectiveness on the tendency of fine magnetic powder to adhere to the line of an otherwise invisible crack when the part is properly magnetized. Adherence of the powder exhibits the crack so conspicuously as to be noticeable from a distance of several feet. In principle, flux lines are forced into the air by the crack and the magnetic powder tends to bridge the path.

This phenomenon was first reported by Major W E Hoke who observed the collection of fine iron particles at surface cracks while lapping with the magnetic chuck. Dr A V De Forest adapted the principle to practical use. First attempts employed a type of fluxmeter which, when moved along the surface, would indicate the presence of a flaw by a sudden change in field density. This method is still very useful for certain inspections.

Turbine manufacturers applied magnetic powder to turbine parts in this country about a decade ago. At that time Westinghouse became interested in the process in the attempt to determine which blades in a damaged row were salvageable, as well as in crack detection generally.

Non-ferrous tanks, Fig. 1, were built large enough to accommodate all turbine blades, with adjustable electro-magnets immediately beneath. The powder used was the magnetic oxide (Fe_3O_4) maintained in suspension in an oil bath by agitation.

In practice, the blade was immersed in the bath, magnetized, taken out and drained, and examined for the tell-tale line of black oxide, much the same as used today for routine inspection in mass production of a variety of products. Even then the importance of flux direction was recognized, as these early tanks were provided with sets of magnets for cross-magnetizing as well as setting up flux in the longitudinal direction, to exhibit longitudinal "folds" as well as transverse cracks.

This apparatus was sent to various power plants but was suitable only for individual blades, removed from the rotor. Additional advantage from testing blades assembled in the rotor was early apparent. Some difficulty was experienced in applying a film with the oxide in suspension, and the powder obtainable then did not dust satisfactorily. It was dry metallic powder made in the laboratory by filing or grinding a piece of cast iron, a tedious process yielding coarse powder.

Testing Assembled Blades

To magnetize assembled blades, electromagnets were made in the laboratory to be held at blade tips, setting up a flux path in the longitudinal direction, at right angles to the position of expected blade cracks. The first tests were made on blades assembled in a rotor segment undergoing fatigue tests in the vibrating machine.

These developments were in progress

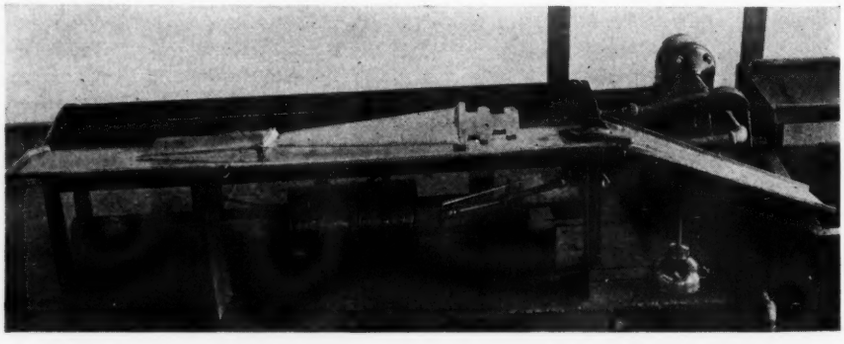


Fig. 1—Magnetic blade-testing tank

in 1929, about the time when Dr De Forest brought out the present dry Magnaflux powder. Very finely divided iron particles are coated with an inert oxide preparation to prevent cohesion, increase the mobility of the powder, and facilitate dry dusting. This powder, greyish white, sharply contrasting with usual dark surfaces of parts in service, has made practical the application of the process to all kinds of parts without disassembly. The method is particularly applicable to blading.

The process is controlled by the Magnaflux Corp, who license users. Its use is well established in automotive and manufacturing fields for parts in production. Much of the practical field-development work in dry-powder testing of turbine blades and parts has been carried out by the author's company whose licenses permit use of the process on turbine blading as well as other apparatus. As these licenses are limited to the company's insurance inspection activities only, increasing demand for blade testing is being met by a field inspection service of the Magnaflux Corp.

Cleaning

Experience has shown that scrupulous cleaning of the surfaces is not necessary; the powder collects readily over cracks covered with thin light scale or oxide. Well-developed cracks can usually be exhibited under a piece of heavy paper. Thick, loose deposits should be removed by wire brushing, scraping, flyash blasting or other means. Oily deposits should be cleaned with a solvent. When the dusting method is used, the surface must be dry, so that the powder is free to move.

Several methods for dusting on the powder have been used, ranging from a salt shaker or a sack of powder on a stick, to various types of sprays. To cover inaccessible surfaces presented by close rows of blading, a common spray bulb with a non-ferrous nozzle (such as is used for sprinkling laundry) has been found satisfactory, especially after a technique of combined throwing and squeezing has been developed. Very little powder is necessary to get effective results. Spraying great clouds of powder with a pump-gun spray is not only ineffective, but messy and wasteful. Tapping the blades lightly assists the powder to collect at a crack.

The important thing is to insure covering critical areas, and some knowledge of blade failure types is essential. Cracks are prone to occur in definite localities. Cracks flush with the blade root are hard to detect, the powder naturally collecting at this junction, as it is a crack so far as the powder is concerned. Cracks one-half to one inch above the root occur on certain types of blading having root "reinforcement." They start usually at the inlet edge. Next, cracks are likely to occur at lashing-wire holes, extending both ways, and some care is required here, as a heavy silver solder fillet may mask part of the crack.

Other types of cracks occur in thin exit edges of reaction blades, usually opposite lashing wires. These may not always be due to simple fatigue and their location may have no relation to points of stress concentration for the several vibration modes. Cracks are also prone to occur at sharp nicks produced mechanically or by corrosion and erosion. An isolated nick is more serious than an edge rough throughout its length. Representative cracks exhibited by the powder are shown in Fig. 2. This powder cannot readily be blown off by the breath, and is thus distinguishable from powder held mechanically, as in a ledge or scratch. Small mirrors of the dental type, on extension handles, and small lights which can be inserted between rows are a valuable aid in detection.

Three Methods

In general, ferrous parts are magnetized by three methods: (1) passing current directly through the part, (2) by applying permanent magnets or electromagnets, and (3) by winding energized cables around the object.

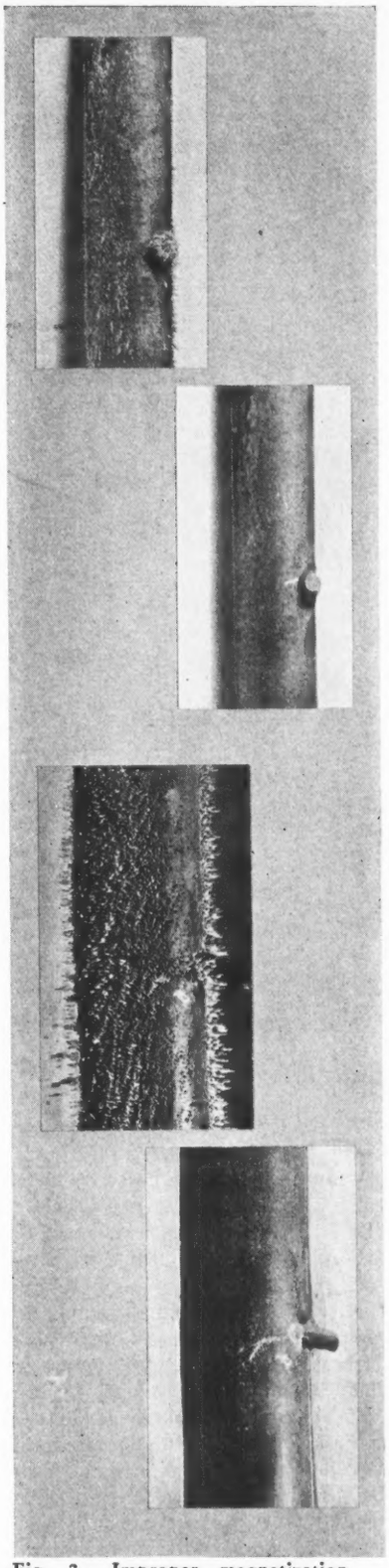


Fig. 3 — Improper magnetization hides cracks, proper magnetization shows them, on same blades

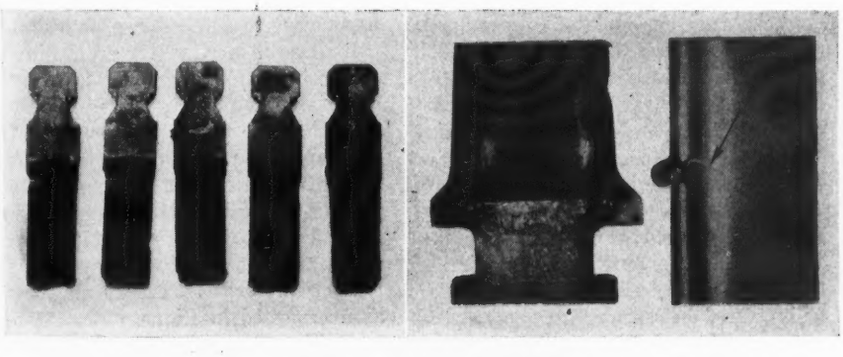


Fig. 2 — Typical fatigue cracks exposed by powder

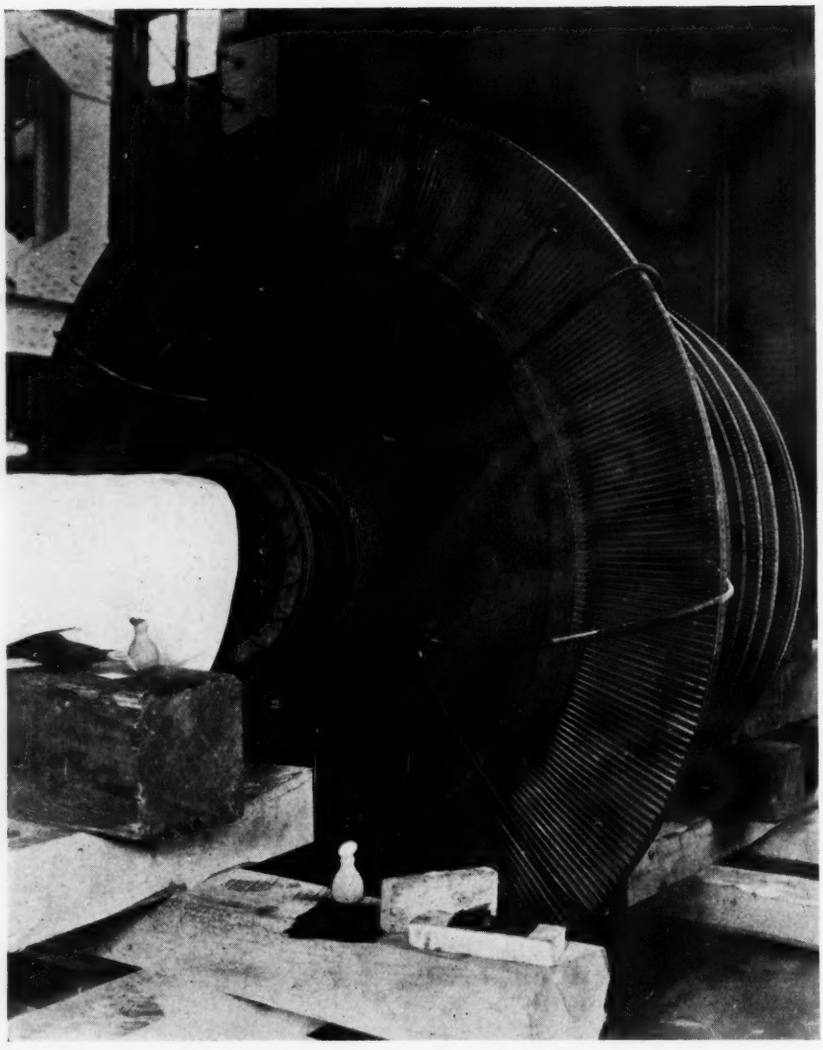


Fig. 4—Toroidal winding for radial cracks

W K Crawford,[1] while associated with Dr DeForest, in 1930, used the "wrapping" method on a great variety of apparatus parts, car wheels, etc. Later, E G Campbell,[2] F Jacobs,[3] and H Johnson[4] experimented with methods of wrapping turbine rotors to magnetize the blading, and established a fairly successful inspection procedure.

Several methods of magnetizing blades and buckets assembled in the rotor have been employed in recent years. By one method, magnetizing one or several complete rows at a time is attempted by wrapping the rotor body with cables carrying current supplied by a portable welding set, using from 500 to 2000 or more ampere-turns. The detail of locating these coils, and the direction of wrapping vary among different users.

Our own experience indicates that magnetizing by shaft winding is not entirely satisfactory. Some blade rows may be magnetized properly, but others become magnetized in such a way that cracks have escaped detection. Also, shaft winding generally necessitates removal of the rotor from the casing, not always desirable.

We prefer to magnetize a segment of one or more rows at a time by means of magnets or external solenoids applied at the periphery of the rows. Special means developed for this type of magnetization have proved very satisfactory and practical—a new type coil designed to operate on ordinary lighting-circuit voltages adaptable to both ac and dc. From 300 to 600 ampere-turns is usually sufficient.

Those experienced in the use of the process can readily determine if proper magnetization has been established by observing the even manner in which the powder adheres to the surfaces. Certain characteristic types of adherence usually evidenced by the collection of "streamers" standing out from the surface (Fig. 3) indicate improper magnetization, wherein the presence of a crack will have little or no effect on the powder.

The tendency has been to establish too great a flux density. In such cases, powder will be strongly attracted to the surface and deposit where it lands without regard to cracks. Quite feeble magnetization, if in the proper direction, is satisfactory. For example, the weak residual in soft-steel plating, not enough to be felt by the pull on a nail, will still show up cracks when dusted with powder. Test for magnetization by hanging a wrench at the shaft end may be meaningless.

The Magnaflux process has proved particularly useful for inspecting for cracks in disk wheels. The powder will show cracks which cannot be exposed by the ordinary whiting test. Fatigue cracks have initiated in both radial and circumferential directions, although of course they tend to follow a scalloped shape in the final stages. Initial radial cracks occur at the rim, particularly at the dowel pin at the start and stop point, and at the hub. Cracks at the equalizing holes are more apt to start off in a circumferential direction, as do other types of cracks at the rim.

Where steam balance holes permit, toroidal or "doughnut" winding (Fig. 4) for ring magnetization is most suitable for disclosing radial cracks. Open solenoid wrapping (not around the shaft between the disks, but enclosing a segment of the disk wheel) Fig. 5, is preferable for checking circumferential cracks. The portable electromagnets are also efficient for detecting disk cracks in any location. It is not necessary to remove the rotor from the casing, but the work is facilitated by so doing.

Straddle-Root Buckets

Cracks in the disk-rim tenon enclosed by straddle-root-type buckets cannot ordinarily be disclosed by the Magnaflux process without removing the buckets. Other magnetic or resistance methods hold little promise. About the only indication observable is the loosening or leaning of buckets or evidence of displacement at the root, and this only after the crack has become well developed. Inspection methods utilizing the change in vibratory characteristics are being investigated, but experience to date is insufficient to determine practicability.

Routine inspection for cracks in the rotor shaft itself is generally limited to the exposed areas, but as the fillets and changes in section between the journals and rotor body, where stress concentrations are to be expected are usually accessible, Magnaflux inspection does afford considerable protection. It must be recognized, however, that circumferential cracks may occur at unexpected locations.

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[1] Metallurgist, Fidelity & Casualty Co of New York
[2] Duquesne Light Co, Pittsburgh, Pa (Deceased)
[3] West Penn Power Co, Pittsburgh, Pa
[4] Westinghouse Electric & Mfg Co (Deceased)

Shatt cracks are readily exposed by magnetizing the shaft as the core of a solenoid. Coil location should be selected to discourage flux lines from emerging into the air normal to the surface being inspected. The portable electromagnets are also fully as useful for this inspection.

Failures of generator-rotor retaining rings have fortunately been rare but when they do occur, the result is disastrous. Many rings retain sufficient residual magnetism for the test, but electromagnets are readily applied to magnetize in the direction suitable for disclosing cracks starting from the ends of the ring. Such cracks have already been found by the Magnaflux method. Inspection for cracks in fan blades and rings have also been made by this process. The "wet" method is generally used for these parts.

The question has been raised as to possible harm residual powder might cause when used on generator-rotor retaining rings, fans, etc. The total amount of powder for a large rotor probably does not exceed half a teaspoonful carefully applied to the surfaces, and is then wiped and blown off in the usual cleaning before reassembly. Curiously, the powder is a non-conductor due to its coating, and infinity megger readings have been noted with the terminals buried in a can of powder.

While it is not generally believed that a few particles of the fine powder which might remain after cleaning would cause any damage, practice is to use impalpable magnetic rouge in oil suspension (the wet method) for such applications. A thin film is applied with a brush.

Removing the Powder

The question of removing Magnaflux powder from turbine rotors has also been raised. The author can see no possible harm from any residual powder remaining after the normal cleaning or blowing out every rotor gets. The bulk of the powder usually drops off when the magnetizing current is broken. Blades are often inspected with the rotor in the lower casing, when it is undesirable to do more than lift the cover. With reasonable care in protecting journals and bearings, and the ordinary cleaning following an overhaul, there should be no cause for concern in using the powder near these locations.

Hundreds of turbines have now been inspected by the Magnaflux process, and so far as the author is aware, there has not been a single case where damage has been attributed to presence of the powder. It is all fine enough to pass a hundred mesh, and the coating is inert. Any remaining powder would represent an extremely small part of the foreign matter normally circulating through any system. Obviously, the insurance carrier would be first to condemn questionable practice.

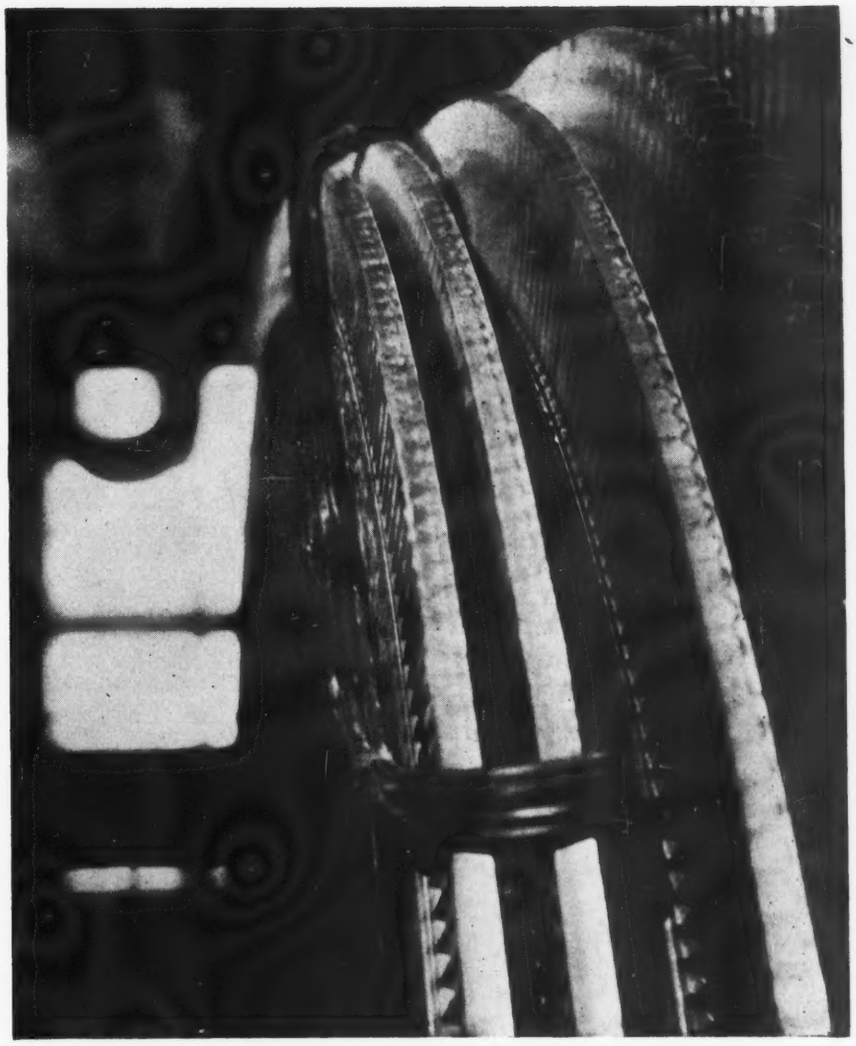

Fig. 5—Segmental wrapping for disks

Demagnetization of turbine parts after an inspection is generally considered unnecessary. There has been no evidence of harmful accumulation of magnetic oxides or particles due to residual magnetism in disks, buckets, and blading.

The question of how often inspection must be made to insure against failures is difficult to answer. It depends on the time required for a crack to progress from an initial stage, undetectable by the process, to failure.

The first inception of a crack can be seen only with a microscope under favorable laboratory conditions, and is indicated by slippage along lattice planes within a crystal. To be detected by the Magnaflux process, the slip has to develop into a definite crack involving a line of crystals, but cracks only a few thousandths of an inch long have been detected.

From this point on, the rate of progress of a crack depends on so many factors that no specific time limit can be set. We have learned of one case where blade failure occurred ten months after inspection, but there may have been some question here as to proper magnetization of the row involved. Other failures within a few months after inspection were due to sudden causes, as heavy tip rubbing.

Conceivably, under certain conditions, true fatigue cracks may initiate and progress to final failure within a few weeks' time, but such failures would be expected to occur shortly after installation. On parts in normal service for a year or more, it is believed that inspections made yearly should catch any cracks developed since the last inspection, before more serious damage is done.

The value of this magnetic test method cannot be seriously questioned. Within our own experience, it has been the means of averting many certain failures, and by the same token, affording assurance when the test result is negative.

★
PUBLIC RELATIONS FOR POWER MEN
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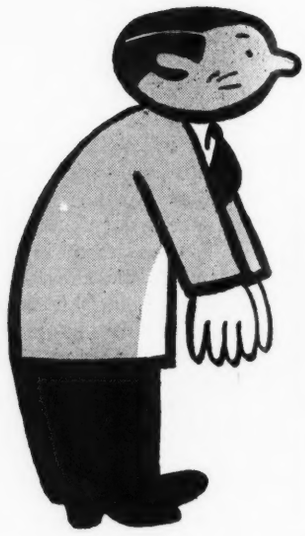


Concurrent Interest

A Philosophy of Industrial Relations

This abstract of a talk presented before the NAPE in Joliet, Ill., gives sensible suggestions for sound employer-employee relations. Subsequent articles of similar nature will continue the public relations program initiated in October POWER

By E W KEMPTON
Director of Industrial Relations
American Steel & Wire Co

"Concurrent Interest" simply means that wage earners and owner are in the same boat

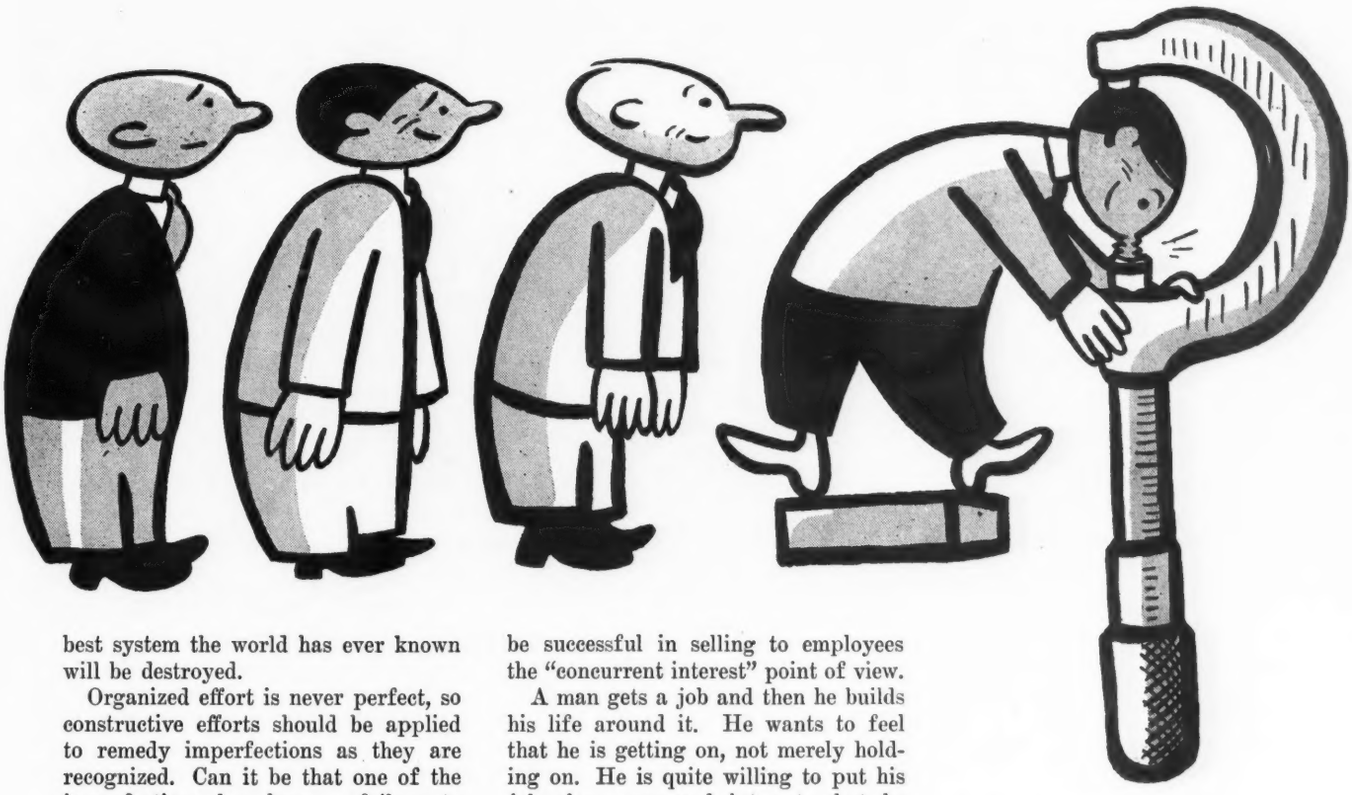
THERE IS HARDLY any phase of business in a large company that is not touched in some manner by this thing we call "industrial relations." That is because industrial relations consists of the every-day relationships between employer and employee, upon which the success or failure of a company so largely depends.

The philosophies of management, as revealed in their personnel policies and procedures, have undergone radical changes in the past hundred years, but the tempo of change has greatly accelerated since the war. Much that has been said in the last few years would seem to indicate that labor problems are of recent origin. Needless to say, that is not true. Students of labor relations have recognized their existence and observed their trend for several decades. Any management far-sighted enough to have recognized the trend could have long since developed a sound labor policy.

The essence of our company's fundamental philosophy is that all dealings with employees shall be upon a basis of "concurrent interest" expressed by our slogan: "What is best for the company is best for employees and what is best for employees is best for the company."

Response to Incentive

An organization requires a willingness on the part of a number of people, not directly concerned with the enterprise, to risk capital in the hope of receiving a reasonable return. In so doing, they provide a means of livelihood for others. Human beings respond to incentive. The growth of this nation and the high standards of living enjoyed by its citizens, despite temporary setbacks, have come about because we do respond to incentive. Remove the incentive of invested capital and the



There should be an effective method of gaging each member of the organization

best system the world has ever known will be destroyed.

Organized effort is never perfect, so constructive efforts should be applied to remedy imperfections as they are recognized. Can it be that one of the imperfections has been a failure to recognize that the term "organization" includes more than the names on the organization chart? Is it improper to discuss the aims, purposes and economics of the business with those who are classed as wage earners, so that they may have a clearer understanding of their stake in the business and the aims of management?

Employees Are Interested

It is only when it is recognized that each member of an organization possesses similar feelings, emotions, ambitions and desires that a full appreciation of the philosophy of concurrent interest is attained. Every thinking individual wants to work for a successful company. Employees have a natural interest in maintaining quality of product, upon which the flow of orders depends, for only so long as orders are received will they continue to work. Employees are interested in scrap and waste as they effect costs, when it is demonstrated that costs affect the number of orders received.

Furthermore, I have found that employees may become interested in stockholders; that they can understand the risks taken by investors and the fairness of a reasonable return on capital investment; that they are interested in such things as depreciation, inventory problems, marketing problems, taxes, etc, when these matters are linked to the successful operation of the company and continuity of employment.

Whether or not employee interest in such matters can be developed depends upon whether or not management can be successful in selling to employees the "concurrent interest" point of view.

A man gets a job and then he builds his life around it. He wants to feel that he is getting on, not merely holding on. He is quite willing to put his job above personal interests, but he must feel that he is progressing and he must understand what it is all about. He is quick to detect insincerity, so we must be serious about this idea of concurrent interest. We must be willing to base our decisions on it; we must be willing to talk to our employees, explain matters and discuss our problems with them.

Who is to do this explaining and discussing? The answer brings into the picture the foreman or supervisor. The man who is in charge of the rank and file—the man who issues instructions first-hand to the wage earners, the man who is the immediate contact with the employee. How much does the foreman know about his company? What kind of a story is he telling his men? What assistance has he received from management to make him competent to render good decisions?

The Minor Issues

Conservatively stated, 95% of grievances presented through grievance committees have to do with actions or decisions of the foremen. They are not major issues. Very few strikes result from major issues. Strikes usually result from a piling-up of a number of small irritations in the minds of the workers—pin pricks in industrial relations.

At first they may affect only individuals or small groups, but, as they accumulate, they spread and unsettle the thinking of the majority of the employees. Since, however, such irritations appear even to the workers to be insufficient cause for a major disturbance such as a strike, the men or their union officers begin to look around for something to use as a major issue. This may be an unconscious reaction but it is nevertheless real. When dissatisfaction exists, it seems entirely natural to ask for a general wage increase or a decrease in hours, or some other interest which holds general appeal to all employees—knowing that only such issues are important to the employer since he is not concerned with minor matters.

There is only one place to eliminate these pin-pricks, these minor issues that are responsible for major disturbances—the point of contact between the worker and his immediate superior, the foreman.

Much has been said in recent years about foreman training, foremen's conferences, but how much real effort has been expended to educate foremen with respect to the questions that lie behind the grievances of employees? The employee today wants to hear from the management, to know about the problems faced; to be a real, live factor in the business; to be part of the organization. He feels that he is a contributor to the success of the company and he wants to be recognized as such. He may not even be conscious of this feeling, but it evidences itself on frequent occasions.

This brings up the question whether or not a man has the right to know the

state of his progress in an organization. Does he have the right to know what his boss thinks of him, and is there a system for the boss to record just what he does think of each individual?

The employee today is thinking in terms of seniority, counterbalancing the insecurity brought about by the ups and downs of the business curve, resulting in layoff and rehiring of employees. More and more, union contracts are embodying the principle of seniority. Under these conditions, what protection does the individual worker have against that foreman or management which gives vent to prejudices and discrimination? The management insists that layoffs and continuity of employment will depend upon ability, but how is ability to be recorded and judged? Are we to depend upon the elastic memory of the foreman and his possible change of mind as his disposition may change from day to day, in a matter that may bring about so much ill will?

A man wants to feel that he's getting on

Keeping the Record

In discussing the rating of workers by foremen, I have frequently been confronted with the argument that the foreman knows who his best workers are, how each performs, and it is, therefore, not necessary to rate them. To my mind if the foreman really knows the ability of each one of his workers, and I think he does, that is all the more argument why he should be willing to record his reactions for the records. Every employee severed from the payroll is a possible grievance case. Any individual laid off or dischargd may claim that such action was based upon discrimination. An employer may at any time be called upon to defend his decisions pertaining to those laid off before a grievance committee or a labor board. What evidence will there be for the record in such an event?

It seems to me that there is as much and more necessity for management to keep a record of the efficiencies and inefficiencies of its individual workers as there is to keep track of the efficiency of machines or the quality of materials used. It has been my experience that grievance committees are much more impressed with the sincerity and fairness of the decisions of management when there is a systematic rating of employees which takes into consideration all of those factors that are considered of importance to the employees and to the management.

Management must continue to insist that continuity of employment be based upon the ability of the worker to do the work, and there must be tangible evidence that the management has a practical method, and has been fair in the administration of that method of gaging all those factors that go to make up ability.

Probably no task of management is more important in the building and retention of an efficient organization than an effective method of rating or gaging each member of the organization, executives, supervisors, clerks and wage earners alike.

Rating may be used as an effective tool for all of the following purposes:

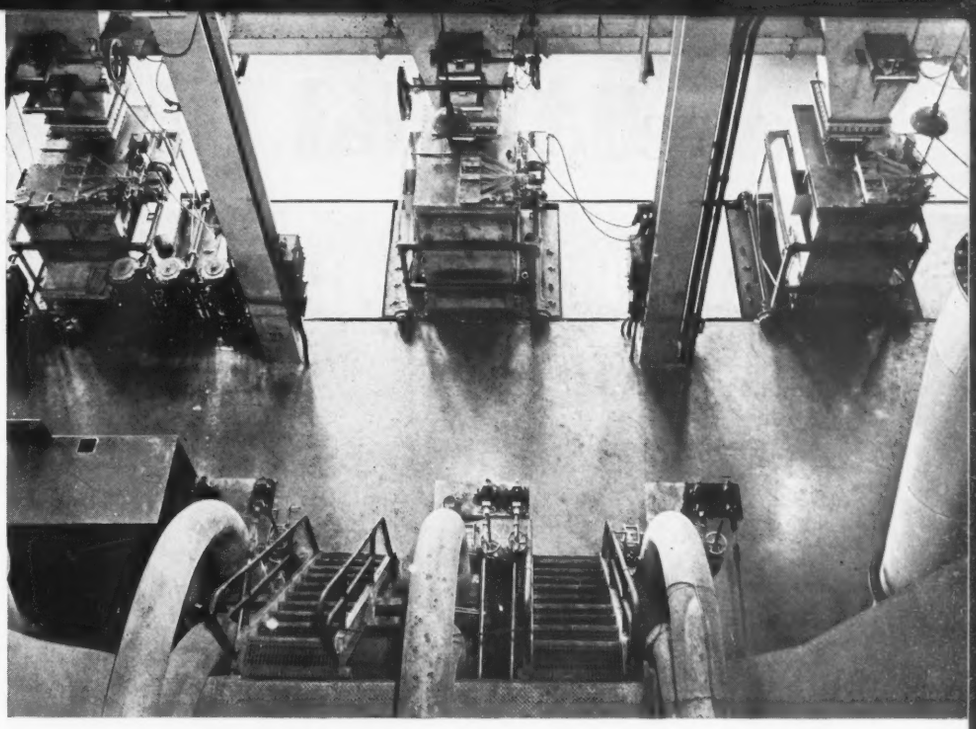
1. To assist supervisors in making a more effective assignment of responsibilities.
2. To provide a basis for promotions, demotions and transfers.
3. To indicate the order of lay-off and reinstatement.
4. To provide a means by which each employee will know definitely what evaluation his supervisor has made of him.
5. To provide a basis for individual improvement after conferences with the supervisor.

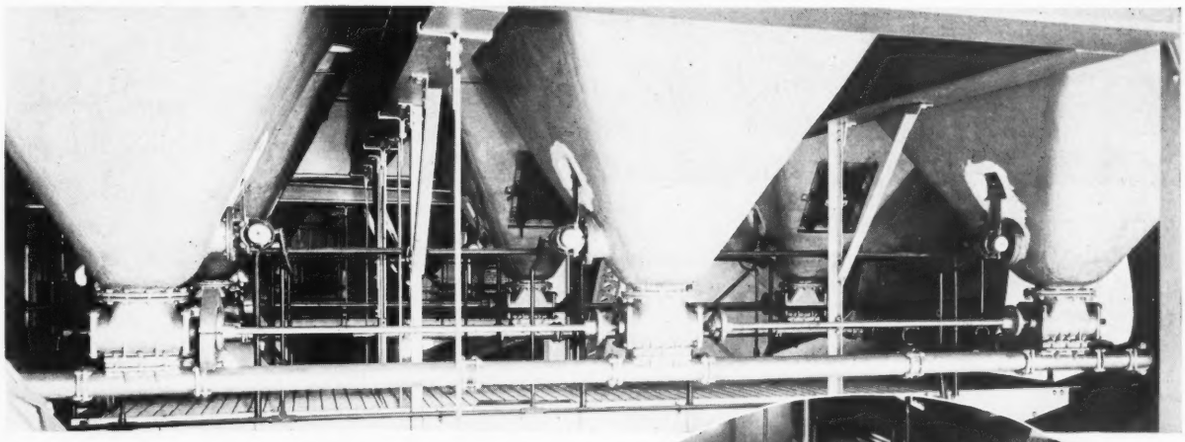
In conclusion, recognize the players in your industrial game. If they do not all thoroughly understand the game, recognize your responsibility to teach them until all come to realize that, between employer and employee, a very definite community of interest exists. Could we bring this about completely, we should have Utopia. This will never be, but it must be the goal toward which we are constantly striving in our industrial relations.

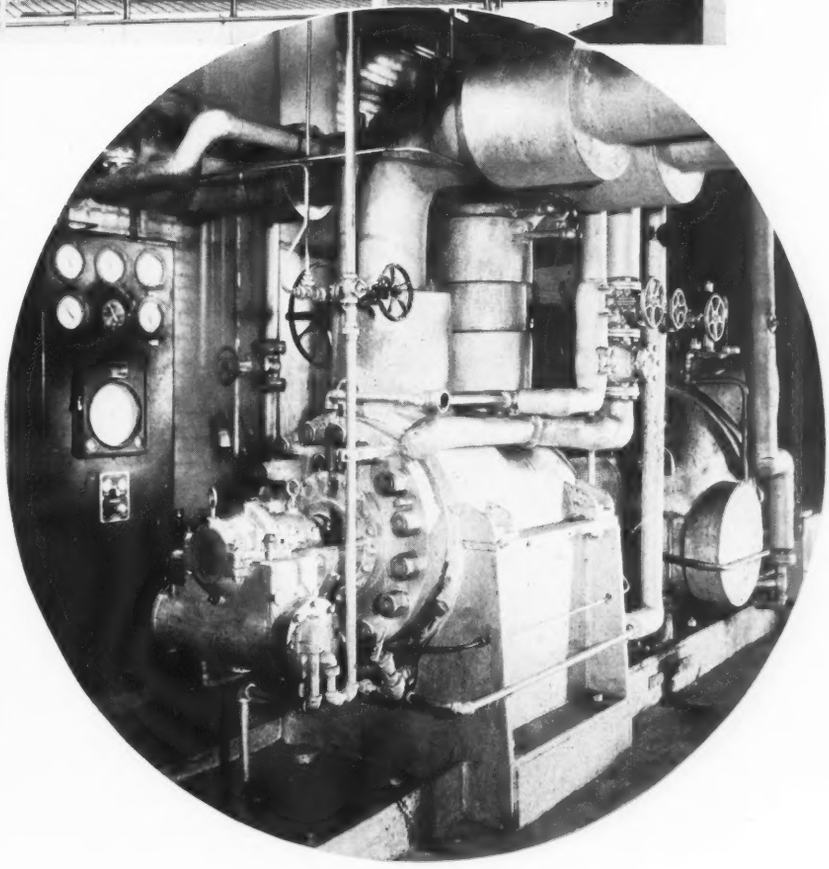
Recognize the players in your industrial game

TRANSIT PLANT

These additional photographs of the Williamsburg power plant described on pages 68-71, show the ample operating space obtained with limited plot area







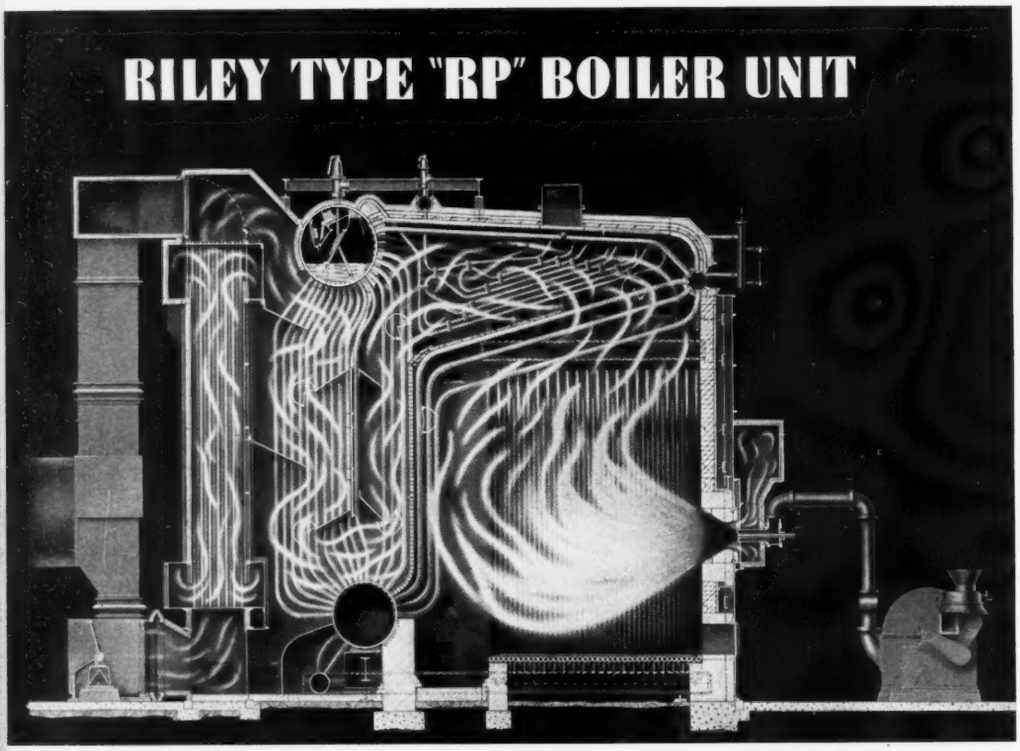
Top—Ample light and ventilation are provided in the boiler firing aisle. This view looks down on the three Richardson coal scales serving Boiler 101. A cross-conveyor, resembling a beam in outward appearance and just visible at top of photo, makes 5000-ton bunker capacity available to any pulverizer combination. In the foreground, flights of steps between the coal pipes lead to the burner platform.

Center — Flyash is removed from precipitator hoppers by a pneumatic conveyor served by a separate feeder at each hopper. Vibrators, visible at the side of each hopper, shake loose flyash from hopper sides.

Below—Three of these 1250-gpm boiler-feed pumps are driven by high-efficiency 200-lb turbines exhausting into 30-lb heaters to complete the heat balance.

These Actual High Operating

RILEY TYPE "RP" BOILER UNIT



Remarkably Efficient Performance can be expected of

RILEY "RP" BOILER UNITS

because of their many Distinctive Design Characteristics

. . . . for capacities between 40,000 and 150,000 lbs. per hour

A LIST OF RECENT RILEY "RP" BOILER INSTALLATIONS

American Bridge Co., Trenton, N. J.
2—35,000 lbs./hr.—275 lbs.
Newport Elec. Corp., Newport, R. I.
2—60,000 lbs./hr.—475 lbs.
Winchester Repeating Arms, New Haven, Ct.
2—75,000 lbs./hr.—725 lbs.
Barrett Co., Philadelphia, Pa.
1—80,000 lbs./hr.—450,000 lbs.
Lewiston Bleachery, Lewiston, Me.
1—70,000 lbs./hr.—450 lbs.
Humble Oil & Ref. Co., Ingleside, Tex.
1—40,000 lbs./hr.—400 lbs.
Bemis Bros. Bag Co., Peoria, Ill.
1—70,000 lbs./hr.—275 lbs.
Hellwig Silk Dyeing Co., Philadelphia, Pa.
1—100,000 lbs./hr.—475 lbs.
Western Cartridge Co., E. Alton, Ill.
2—75,000 lbs./hr.—725 lbs.
Natrona Pr. & Lt. Co., Natrona, Pa.
1—90,000 lbs./hr.—450 lbs.
Brisban Co., S. J., South America
1—36,000 lbs./hr.—425 lbs.
Central Ohio Lt. & Pr. Co., Bluffton, O.
2—60,000 lbs./hr.—450 lbs.
Union Public Service Co., Canby, Minn.
1—60,000 lbs./hr.—500 lbs.
Lexington Water Works, Lexington, Ky.
1—15,000 lbs./hr.—325 lbs.
Riverside Metal Co., Riverside, N. J.
1—65,000 lbs.,/hr.—450 lbs.
Crown Cork & Seal Co., Baltimore, Md.
1—90,000 lbs./hr.—200 lbs.
General Aniline Co., Rensselaer, N. Y.
1—80,000 lbs./hr.—250 lbs.
Port Huron Sulphite and Paper Co., Port Huron, Mich.
1—80,000 lbs./hr.—675 lbs.
Suchar Process Corp., Yonkers, N. Y.
1—60,000 lbs./hr.—250 lbs.
Great Lakes Steel Co., Detroit, Mich.
2—100,000 lbs./hr.—450 lbs.
Northern Paper Co., Green Bay, Wisc.
2—75,000 lbs./hr.—700 lbs.
Wheeling Steel Co., Portsmouth, Ohio
1—100,000 lbs./hr.—660 lbs.
Guide Lamp Co., Anderson, Ind.
1—50,000 lbs./hr.—275 lbs.
N. Da. Power & Light Co. Bismarck, N. D.
2—35,000 lbs./hr.—450 lbs.
Yazoo Municipal Plant, Yazoo, Miss.
1—60,000 lbs./hr.—275 lbs.
Hartford City Paper Co., Hartford City, Ind.
1—55,000 lbs./hr.—350 lbs.

As more and more Riley "RP" units are placed into operation, the remarkable efficiency of the Riley "RP" unit becomes more definitely established.

The many distinctive design characteristics of Riley "RP" Steam Generating Units are responsible for the remarkably efficient performance being obtained in the operation of these units. Performance which invariably has exceeded guarantees, thereby giving Riley users more than their money's worth. The design of the Riley "RP" unit not only assures high operating efficiency but also a unit of lowest possible initial investment cost consistent with good workmanship and materials, and a unit which can be installed under extreme space limitations.

The Riley "RP" unit is distinctive in design. The general shape of the front tube bank assures rapid circulation of boiler water, maximum area of radiant heat absorption surface, eliminates stratification of gases and the consequent by-passing of portions of the boiler heating surfaces and gives the maximum amount of furnace volume at low cost. The design of the "RP" unit makes possible the use of efficient cross flow of gases over the boiler heating surface. 2½" tubes are used in the last tube bank to obtain the largest possible amount of tube surface and the most effective utilization of the convection surface of the unit.

These are just a few of the many distinctive design characteristics of Riley "RP" steam generating units. A Riley engineer will gladly give you additional information about Riley "RP" units; detailed information about results in other plants; layouts of how they can be installed in your plant; savings which you can expect through the installation of them.

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STOKER CORPORATION, WORCESTER, MASS.

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It will pay you to visit modern Riley Installations

Efficiencies of RILEY "RP" Boilers *assure large fuel savings*

Names of plants on request

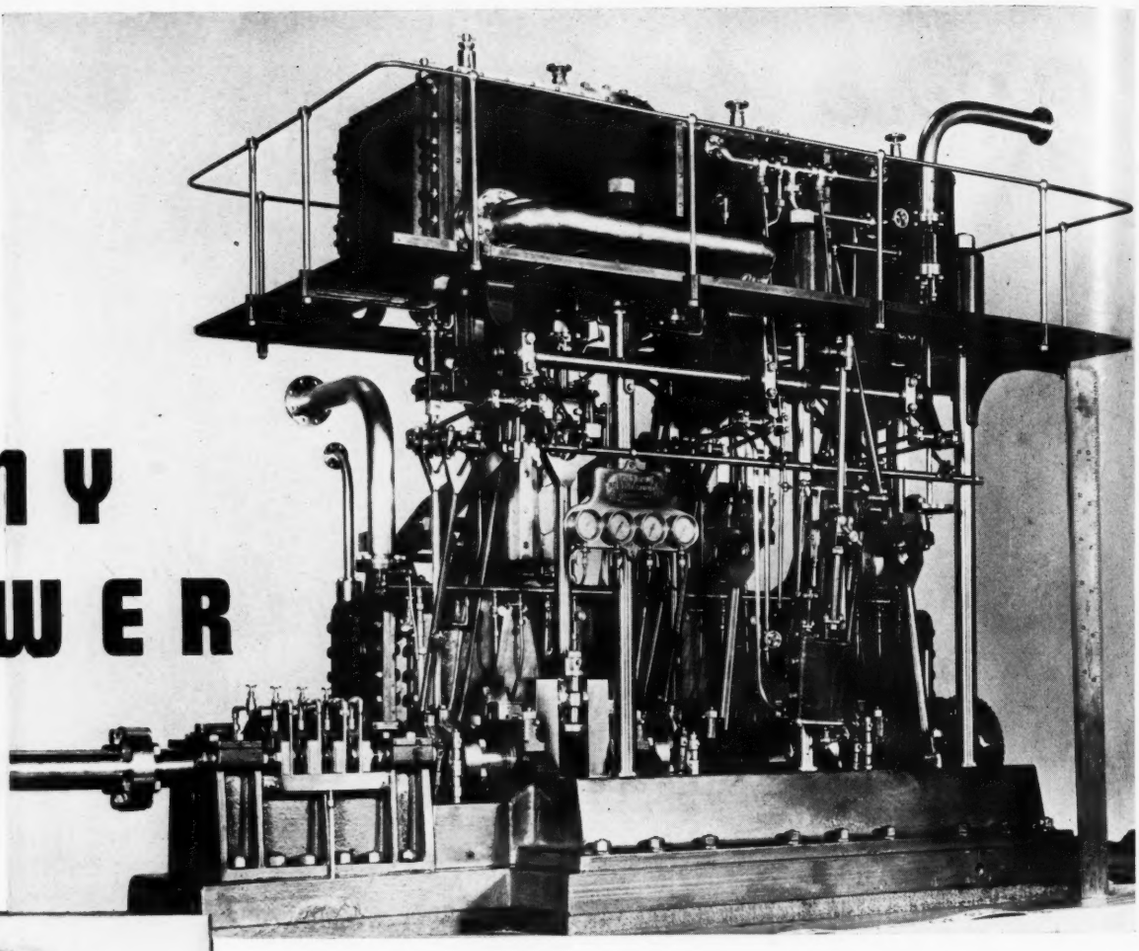
A survey of your power plant by a consulting engineer will possibly show ways of making surprisingly large savings in power costs

COMPLETE STEAM GENERATING UNITS

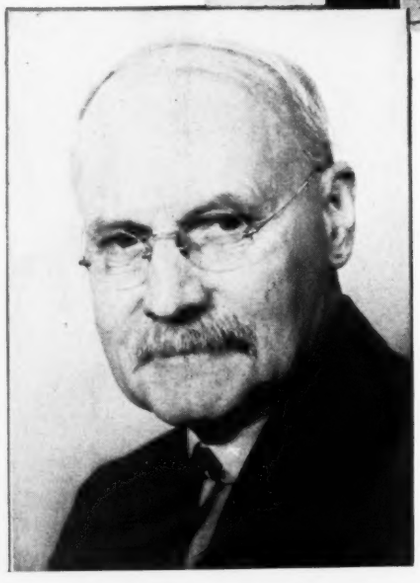
BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • AIR HEATERS
ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • FLUE GAS SCRUBBERS

before purchasing Boiler or Fuel Burning Equipment

Fig. 1—Three-cylinder, triple-expansion, condensing marine engine. Bore of high-pressure cylinder is 1 13/32 in.; of intermediate, 2¼ in.; of low, 3 21/32 in. Stroke is 2½ in. Over-all dimensions are 17¼ in. high, 11 in. wide, and 22 in. long



PONY POWER



FRED D HOOD

"My advice to anyone contemplating building a plant of this kind is to start young and keep a little bank account handy to be sure of finishing."

MODELMAKING calls for infinite patience and rare attention to detail—but it's a heck of a lot of fun, as Fred D Hood, Los Angeles, Calif., well knows. He has spent eight years building this marine engine and boiler, and its going to take about another year to finish the job.

Everything is exactly to scale, even the jack and sawhorse under the boiler in Fig. 2. The largest screw thread on the engine, ⅜ in.-24, is on the top and bottom of front stanchions; the smallest, No. 0-80 machine screw, secures the lagging bands at top and bottom of cylinders. The four pressure gages, Fig. 1, are for high-pressure steam chest, intermediate-pressure receiver, low-pressure condenser and receiver. The gages, incidentally, contain the only finished pieces that were bought—the gage hands are watch second hands. All other parts were made from iron and brass castings, bar steel, iron and brass tubing.

To facilitate setting piston valves, aluminum duplicates were made of high- and intermediate-pressure valve chests with the sides cut out so that registering of valve edges with valve ports could be observed. The largest engine bearing, ¾ in., is in the crankshaft; the smallest, $\frac{3}{64}$ in., is in the link pins of the floating valve gear.

The boiler, says Mr Hood, presented much more construction difficulty than the engine. Months were spent in experimenting on a tube expander for $\frac{5}{16}$-in. tubes of a little less than ¼-in. inside diameter. Final result was an exact duplicate of an old-fashioned Dudgeon tube expander, consisting of four hardened-steel rollers, $\frac{1}{16}$-in. diameter by $\frac{5}{16}$-in. long, held in a separator and forced outwards by a tapered mandrel pushed in and revolved by a crank. After considerable practice, Hood was able to establish a record of expanding and heading one tube in about 15 minutes.

Making the Boiler

Stay tubes are threaded into both tube plates, there being 106 $\frac{5}{16}$-in. tubes altogether. The shell, 12-in. long by 12-in. inside diameter and ⅜-in. thick, was made from high-grade steam pipe with internal thread to receive heads fashioned from 1-in. steel disks, externally threaded and shaped out to

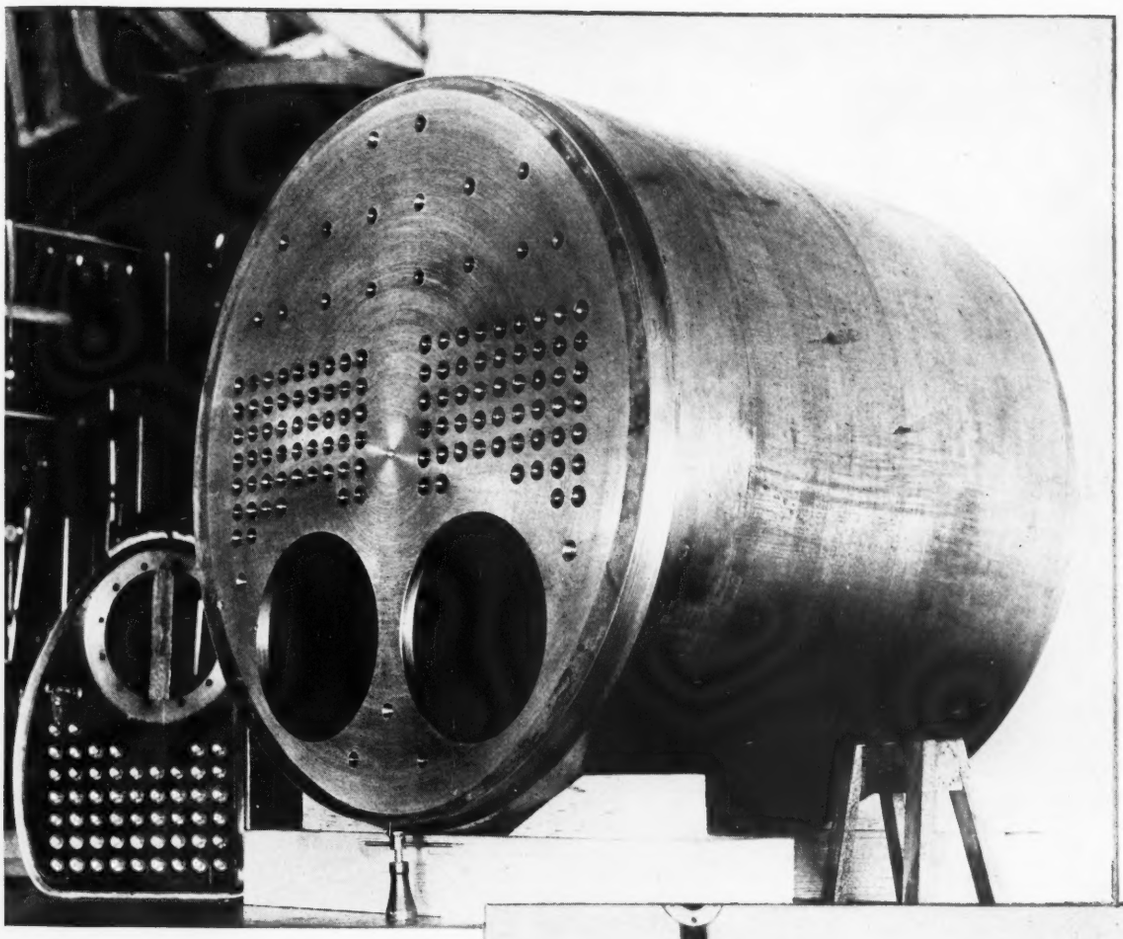


Fig. 2—Boiler shell with the heads screwed in. Note jack and sawhorse to scale

Fig. 3—Piston and valve rods are stainless steel with metallic packing. High- and intermediate-pressure valves are piston type; low-pressure is flat double-ported with false valve face attached to main casting

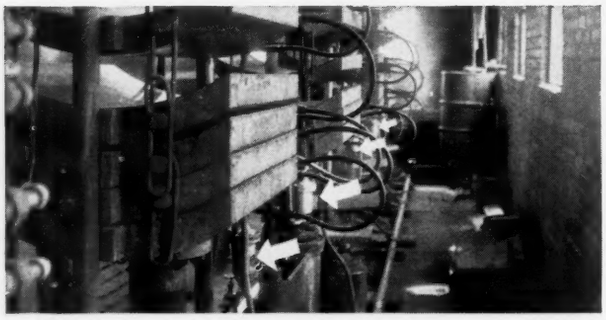
17/64-in. thick except at the flanges.

Mr Hood had originally planned to arc-weld the heads in addition to threading them into the boiler shell. At this point, a Los Angeles boiler inspector stated that the boiler would have to be stress relieved, inasmuch as the builder planned to operate at 125-lb pressure (see ASME Boiler Construction Code for Power Boilers). Mr Hood, not wanting to risk warping the result of eight years of work in stress relieving, objected.

After much consultation, a plan was worked out agreeable to both. Present scheme is to screw the heads into the shell, then make steel rings and slide them over the heads up against the end of the shell and silver-solder in place. These rings are to be something on the order of piston rings, bore being equal to boiler-head diameter, outside being equal to outside diameter of shell, and they will be about $\frac{1}{4}$ in. thick.

When the boiler is completed, boiler inspectors will cover the heads with plaster of Paris and apply 240-lb hydraulic pressure. If the plaster does not crack, they will allow a working steam pressure of 120 lb.

How you can

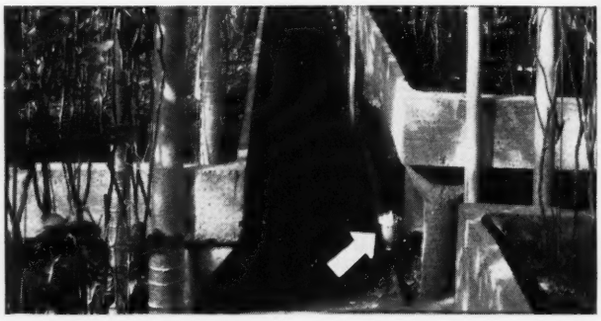


WOOD WORKING PLANT

Bending chair backs formerly took sixty minutes press time at the Union Chair Co., Union City, Pa. With Armstrong traps installed, this time was cut to thirty minutes. It was particularly fortunate that this increase in production capacity came just when the Union Chair Co. needed it most.

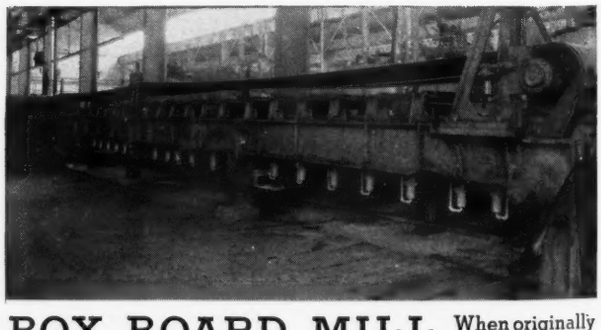
CANDY MAKER

The Nutrine Candy Co. of Chicago needed more capacity. A test was made with Armstrong Unit Trapping and new return lines. On the crystallizers shown above, cooking time was cut as much as 14% per batch. Subsequently, a total of 64 Armstrong traps were put in and one boiler now handles the load that formerly kept two busy.



GREENHOUSE

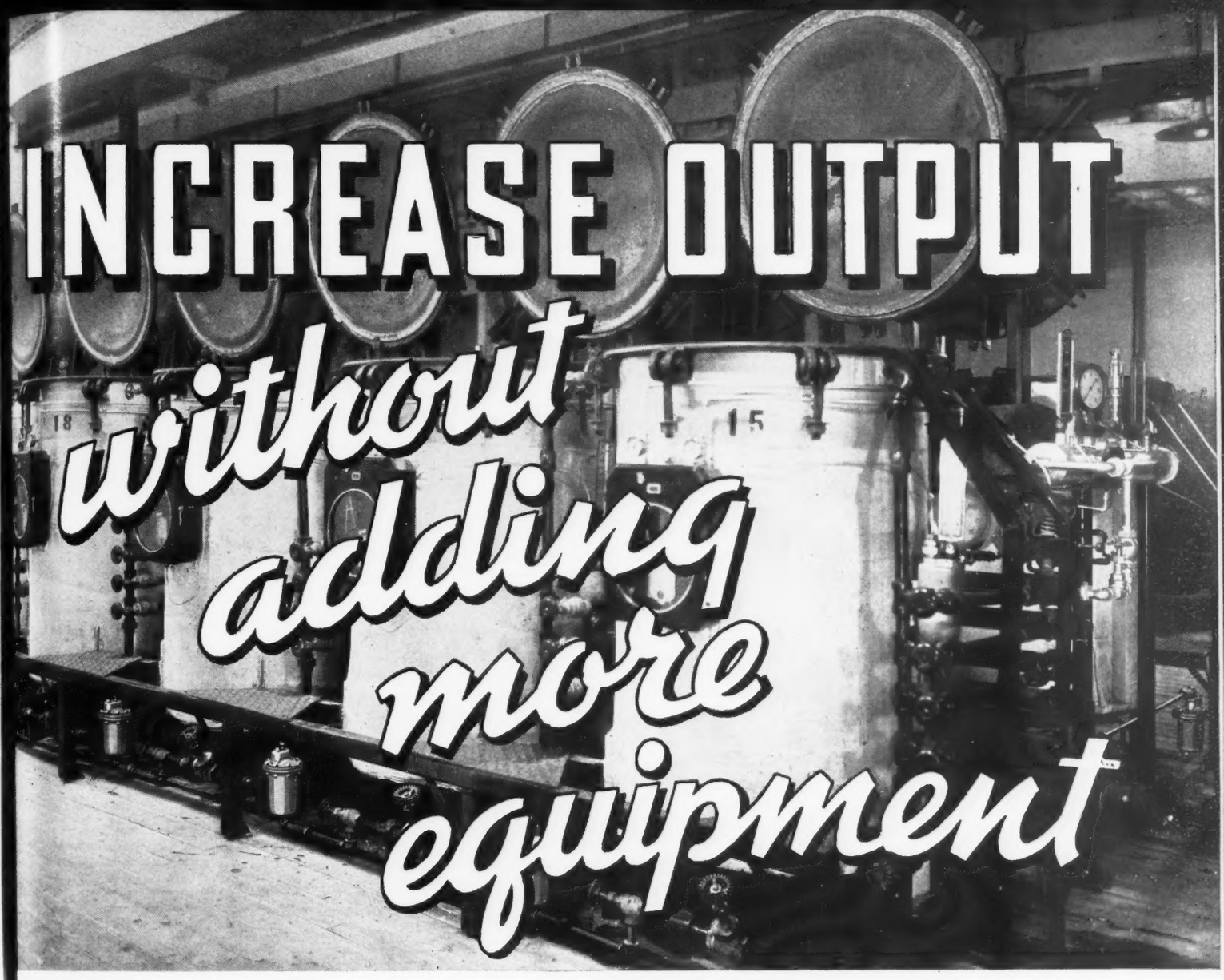
Recently, the Pittsburgh Cut Flower Co. changed over a rose house to No. 200 and 201 Armstrong traps for draining individual heating coils. These traps are now given credit for increasing bloom production 38% by eliminating harmful irregularities in temperature.



BOX BOARD MILL

When originally installed in the Bradford, Pa., mill of the Northeastern Container Corp., the big corrugating machine shown here was equipped with one trap per section of drying plates. In order to get results, the crew had to open up by-passes that wasted a lot of steam. Now, with a No. 211 Armstrong trap on each plate, temperatures are uniformly higher, production has increased, and steam consumption has been greatly decreased.

Change over to ARMSTRONG



HERE is an idea that is paying big dividends to users of steam in all branches of industry: ARMSTRONG UNIT TRAPPING! By putting individual Armstrong traps on each chest . . . coil . . . header . . . or roll, you will be positively insuring against water-logging . . . short-circuiting . . . air-binding . . . and sluggish drainage! In addition, you will also be stopping wasteful steam leaks and preventing dissipation of pressure needed to maintain desired temperatures.

Examples of benefits being secured by some of the typical users appear on the opposite page. In the above picture, individual Armstrong traps can be seen draining big retorts in one of Chicago's largest packing plants—84 traps for 84 retorts! This also was a case where maximum output has been combined with minimum steam consumption.

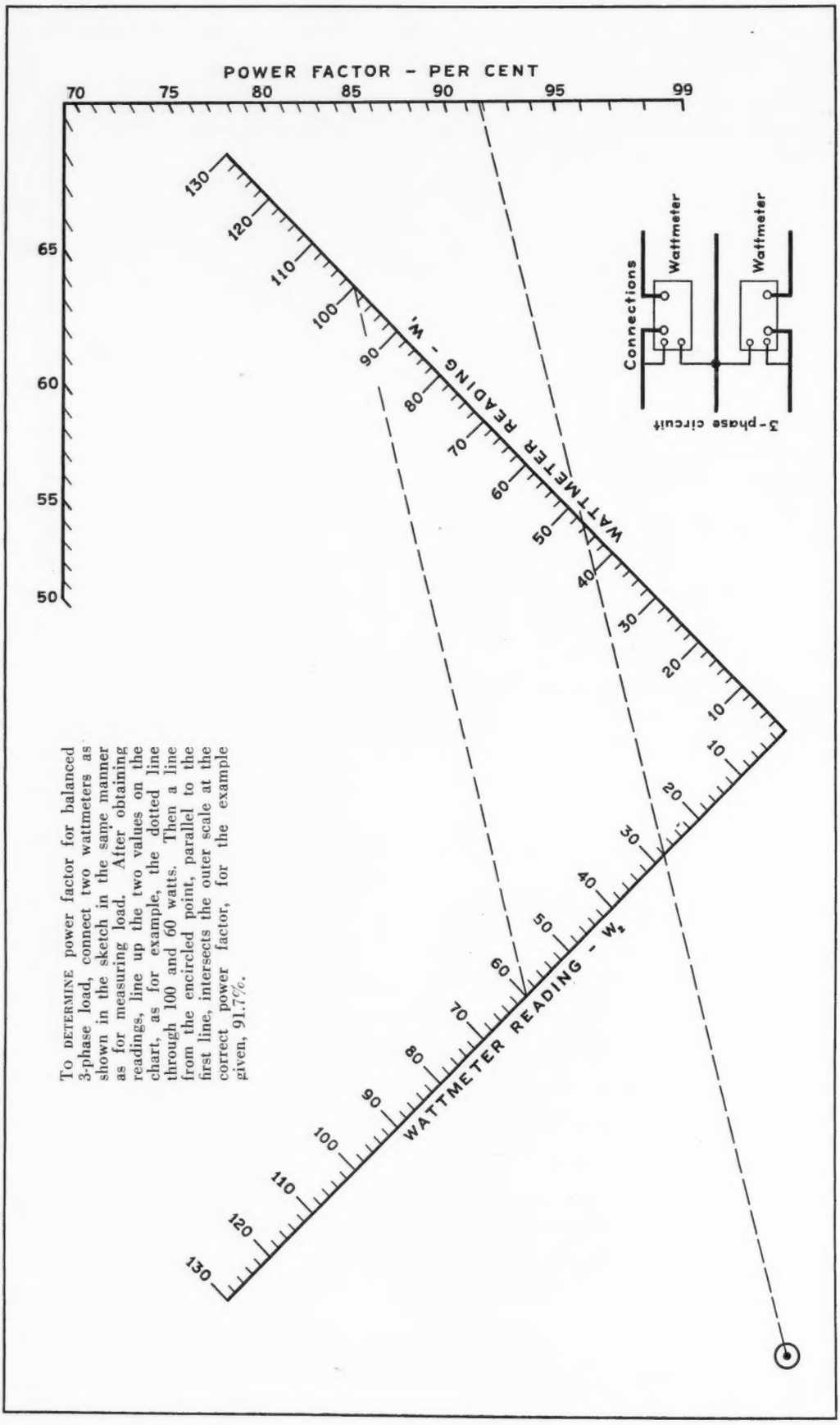
Armstrong traps are offered in a complete range of sizes for any pressure. And in each one you get the long-life Armstrong inverted bucket operating mechanism. Get the traps you need now. Catalog free on request.

ARMSTRONG MACHINE WORKS
812 Maple St., Three Rivers, Mich.

UNIT TRAPPING

Number 75

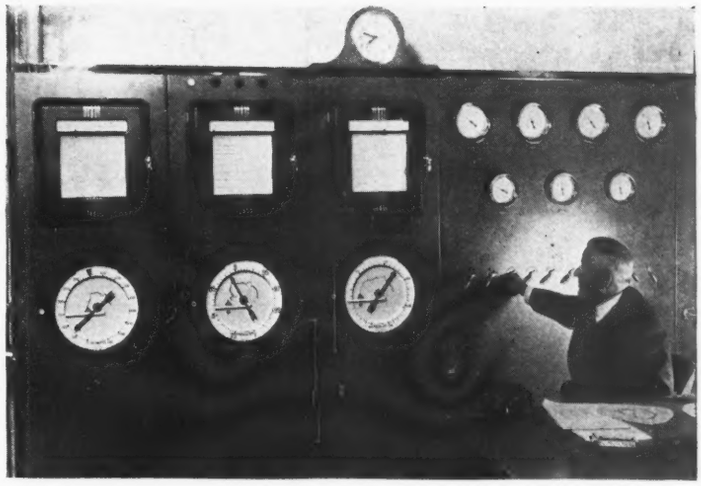
Power Factor From Two Wattmeters



To DETERMINE power factor for balanced 3-phase load, connect two wattmeters as shown in the sketch in the same manner as for measuring load. After obtaining readings, line up the two values on the chart, as for example, the dotted line through 100 and 60 watts. Then a line from the encircled point, parallel to the first line, intersects the outer scale at the correct power factor, for the example given, 91.7%.

© POWER

Centralized instrument installation improves operation and cuts cost of services at Leeds & Northrup Philadelphia plant



Instrument panel across one office wall gives maintenance engineer fingertip control of power services.

They Take Their Own Medicine

"THE shoemaker's children are the poorest shod"—so runs an old saw. Apparently the plant engineers at Leeds & Northrup's Philadelphia factory never heard this one since they recently have taken another dose of their own medicine by completing an interesting job of instrumentation in their own plant.

Its feature is centralization of instruments on a new panelboard in the maintenance engineer's office, giving him literal fingertip control of the plant's power services. These services include electric power, compressed air, and heating. With no process-steam load, it is more economical to purchase power, so all energy is bought from the Philadelphia Electric Co. Motor-driven compressors supply air, and heating steam is generated in a battery of hand-fired boilers. Improving the operation of these services and cutting their cost is the function of the instruments.

Controls for the heating plant are unique. Immediately behind the maintenance engineer's desk is a row of 10 levers, nine of which regulate air-operated valves on steam lines running to different parts of the factory. Temperature conditions in 16 sections of the building are shown on the 16-point recorder at the top of the panel to the left of the desk. Each minute, the instrument records the temperature in some one part of the plant, covering the entire 16 sections in sequence, every 16 minutes. These temperatures guide operation of hand levers controlling steam flow to the building sections. Experience has shown that by suiting steam supply to variations in outside temperature, wind direction and sun exposure, better heating is had with less steam.

At the top of the second panel to the left of the desk is a smoke recorder. Differences in density of a continuously flowing sample drawn from the stack by an aspirator are measured by a recorder connected to a thermopile. Five signal lamps above the recorder are operated by it so that one flashes when smoke is below 20%, two when smoke is between 20-40%, and so on. A simi'ar set of lamps in the boiler room warns the fireman when excessive smoke is being formed so he can correct boiler conditions. For example, it has been found that heavy smoking during firing can be eliminated by starting a fan which forces a draft of air across the firebed.

Functions

The recorder at the top of the panel at the extreme left measures CO_2 by changes in thermal conductivity of a continuously-flowing sample drawn from the stack by an aspirator. Seven indicating pressure gages above the regulating levers give pressure of domestic water, fire-sprinkler water, steam, compressed air, air for aspirators, air on Johnson thermostats, and vacuum on heating-system returns.

Remaining instruments give data that helps keep down cost of purchased power. From left to right they are a load recorder, a power-factor recorder, and a voltage recorder. Load and power-factor recorders work together to cut power bills by eliminating, as far as possible, excess-demand charges. P'ant load is served by two transformer banks, one for light and one for power. A 3-position switch on the load recorder makes it possible to read load in either bank or total load. As now operated, the load recorder warns when load nears the permissible limit, and load is dropped. Heavy load from electric furnaces which can be shut down for a few minutes at a time without inconvenieneing manufacturing departments, makes momentary load reduction possible.

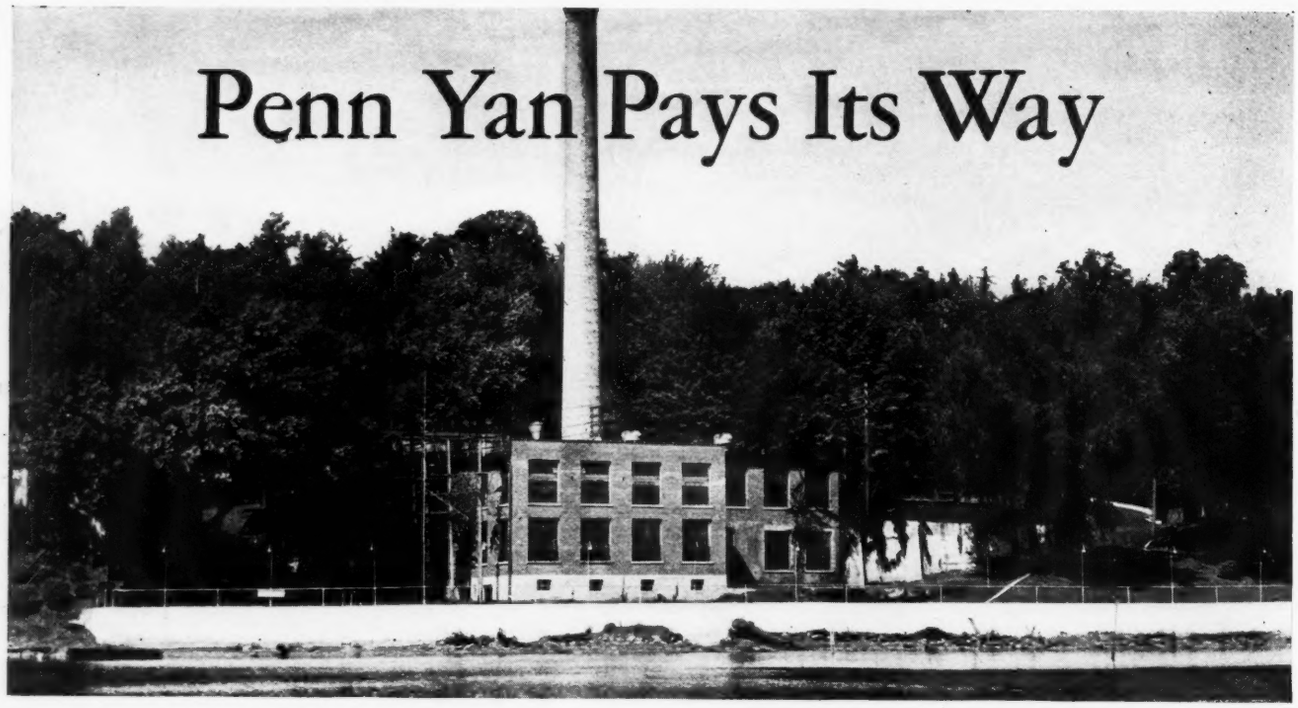
Collecting Data

Ultimate development will be automatic control of load, based on a schedule that shuts down the right furnaces in the right sequence and at the right points on the load curve. Load demand under all conditions must be known to fashion such a schedule, and the recording instruments are collecting the needed data right now.

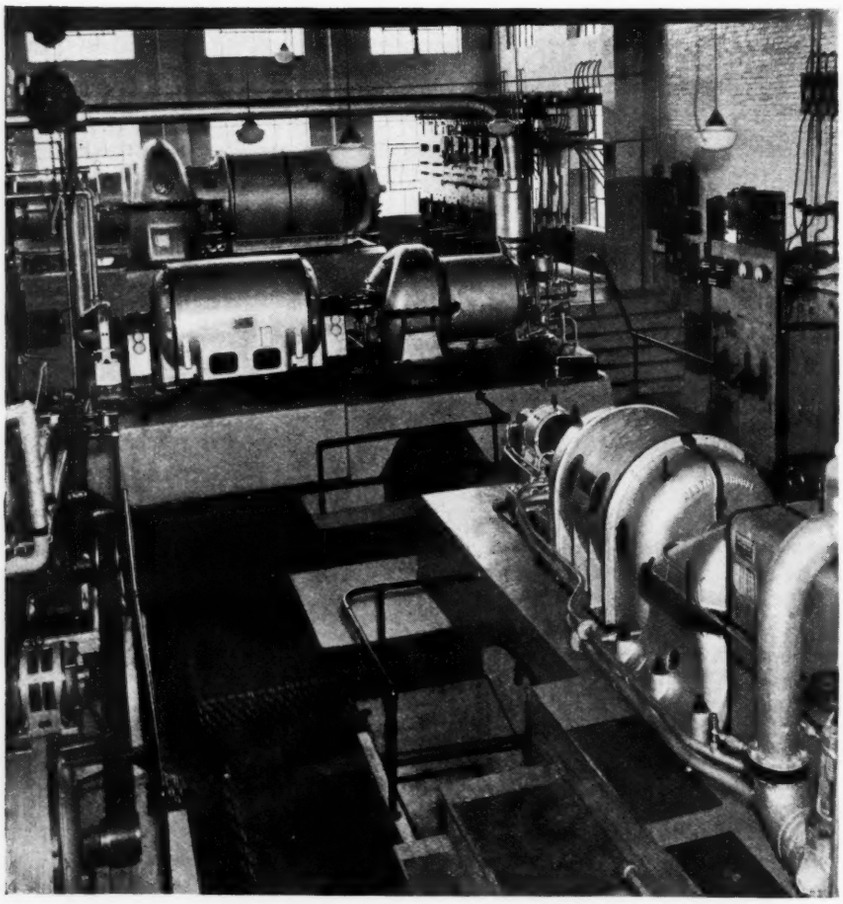
Dropping big chunks of unity-power-factor load can't be done without affecting the over-all power factor and the recorder for that condition shows just what happens. This recorder's chart supplies data for the constant fight to improve power factor, which should average 0.9 to meet the requirements of the electric company's rate. A check of motor drives has shown much equipment overmotored; replacing with sma'ler motors will cut inductive load. A program for limiting all motors over 10 hp to the synchronous type with 0.8 leading pf is also helping the improvement.

The voltage recorder measures secondary voltage from any leg to ground in either lighting or power banks, by means of an 8-position switch. With its data, changes in distribution of load on phases have been made to improve voltage conditions. Abnormalities in its readings help the maintenance department to isolate trouble.

Penn Yan Pays Its Way



This New York municipal plant has bought new equipment out of earnings, maintained consistently low rates, and paid out $52,000 in dividends to consumers in eight years



Main engine room houses three largest turbine-generators; another unit is in adjoining pump room

POWER USERS in Penn Yan, N. Y., got a month's free service this year, worth about $5500 to the 2232 customers of the municipal power plant. It wasn't exactly a surprise, however, as they have now received a total of $52,000 in such dividends in the past eight years. So is confirmed the decision, back in 1905, to build a municipal utility and so is justified the $49,248.88 of tax money used to pay off principal and interest on the bond issue for the original plant. Recipe for Penn Yan's success seems a combination of careful purchasing of equipment, economical plant operation, and low overhead.

The original plant, with engine-driven generators, was built on the shores of Lake Keuka, alongside the municipal waterworks which had been in operation since 1894. Practically nothing of either old plant is left, the result of constant modernization and enlargement. The present plant, with a gross capacity of 3800 kw, supplies more than 2000 residential and industrial consumers in Penn Yan, the town's street lighting, and power for the waterworks pumping station. Since the plants are in the same building, the price of current for the waterworks (2.5 cents per kwhr) includes operation and maintenance of the pumping equipment.

Oldest unit in the present power plant, and first step in modernization of the old, is a 300-kw, 6300-rpm Westinghouse turbine, with jet condenser, driving, through gears, a 900-rpm, 2-phase, 60-cycle, 2300-volt ac generator. In 1926, a 3600-rpm direct-drive West-

inghouse turbine, also with jet condenser, increased capacity by 500 kw. Since that time, peak load and number of customers have just about doubled, consumption per meter has tripled, and the kwhrs generated have increased by about 5 times. Further heavy load increase is anticipated as low rates make increasingly attractive the use of electric stoves, water heaters, and other high-consumption appliances.

More recent additions to generating plant were made with these considerations in mind. In 1930, a 1000-kw, 3600-rpm Moore turbine direct-connected to an Allis-Chalmers generator, fitted with a C H Wheeler jet condenser, was installed. Latest addition is a 2000-kw, 3600-rpm General Electric turbine-generator with a Westinghouse surface condenser, bought from the Rochester, Minnesota, municipal plant, which had outgrown it. This unit cost little more than a new surface condenser alone would have cost, and came complete with turbine-driven circulating pump, steam-jet air ejector, condenser piping and spare parts. A radiator in the duct leading from generator housing, supplied with circulating water, cools generator air.

A new extension on the face of the brick power-plant building houses this unit and also a new metal-clad switchboard mounting modern breakers, instruments and carbon-pile voltage regulators.

Condensing Water

Condensing water is taken from Keuka Lake through intake pipes extending several hundred feet from shore. Under normal operation, all condenser pumps are motor-driven, but the circulators for the two large units are equipped with steam turbines for emergencies.

Gradual replacement of old boilers and firing equipment has increased boiler-room efficiency. First step was the installation, in 1927, of a 2500-sq-ft, straight-tube, cross-drum, Babcock & Wilcox boiler fired by a Detroit single-retort underfeed stoker. Successful operation indicated an almost immediate second dose of the same medicine, and in the following year a 3750-sq ft boiler of the same design, equipped with a Detroit double-retort stoker, was placed in service. Finally, in 1932, purchase of a 6000-sq ft B&W unit with Detroit triple-retort stoker completed modernization in the boiler house.

In all units, superheaters raise steam temperature 100 F above saturation temperature for 160 lb; on the first and last units the equipment is Babcock & Wilcox, on the 3750-sq ft boiler it is Foster Wheeler. All boilers are equipped with Bailey steam-flow, air-flow meters. Copes regulators control feed to the first two, and a Bailey regulator does the job on the 6000-sq-ft boiler.

Stokers, which are of the plunger-feed type, with adjustable stroke, are driven from a line shaft running under the floor. An under-floor air duct at the front of the boilers supplies forced draft. Stoker line shaft and Clarage forced-draft fan are driven by a 6x6-in. Troy-Engberg engine. A weighted-lever regulating valve controls engine speed in accordance with changes in steam pressure and thus adjusts coal feed and air volume to meet load requirements. An auxiliary motor can drive the line shaft through a clutch, and an auxiliary motor-driven fan is located at the far end of the air duct. A 138-ft radial-brick stack on a separate foundation outside the building supplies induced draft.

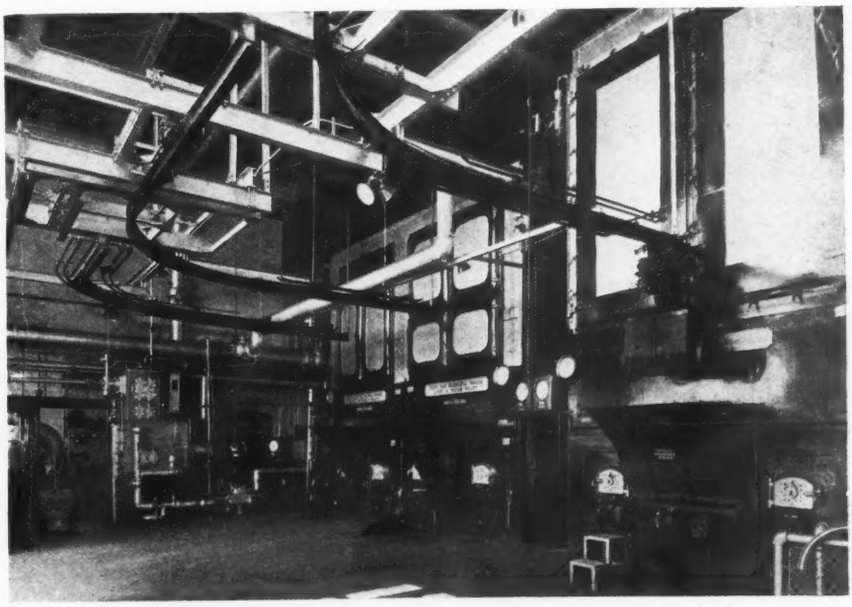
Good results have been obtained with W. Va. bituminous coal (1x2-in. screened nut). Main coal storage, 1500 tons, is located in the town. Trucks deliver coal to the plant, dumping into an open concrete storage bunker outside the building. Handling inside the boiler room is by an overhead trolley system, with a motor-driven hoist to raise coal to hopper.

With good water available (only about 6 grains hard), and little makeup required when the 2000-kw unit, with its surface condenser, is running, no feedwater troubles have been encountered. Zeolite treatment, with salt-brine feed, removes hardness; two units, one Permutit and one Hungerford-Terry, divide the job. A Cochrane open heater, into which steam-driven auxiliaries exhaust, heats boiler feed. Consideration is being given to a larger heater of the deaerating type and to a centrifugal turbine-driven feed pump.

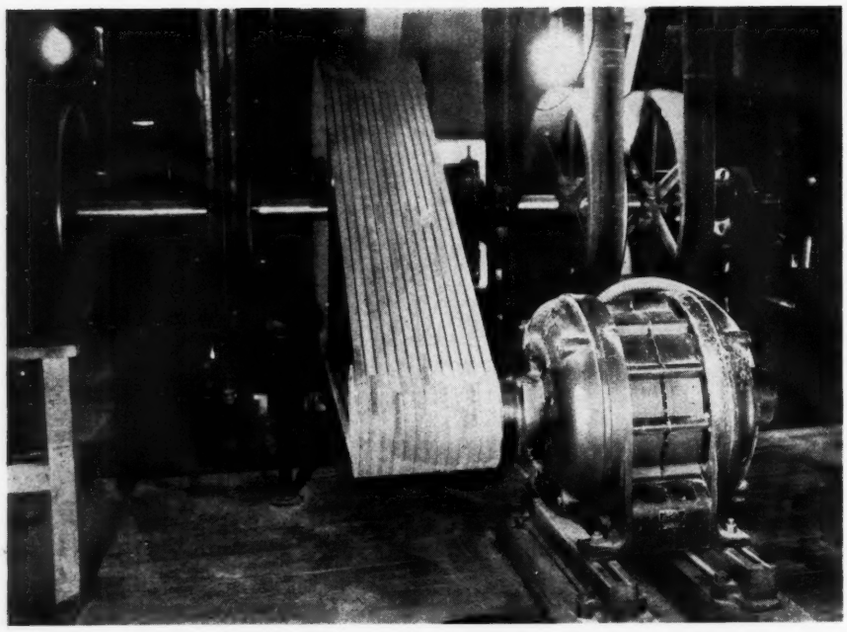
Operating figures give some idea how this municipal utility saves money for its consumers. During 1938, 2,931,887 kwhrs were sold to general consumers at an average rate of 2.2 cents and 822,198 kwhrs were sold to the municipality at an average rate of 2.3 cents. Of the latter, 602,419 kwhrs went to the pumping plant next door at a price which included maintenance and attendance of pumps and station piping. In the same year, 5077 tons of coal were burned, giving an average of 2.33 lb per kwhr, and average fuel cost of 0.57¢ per kwhr.

The plant has never incurred an operating loss, and improvements described, costing in excess of $210,000, as well as numerous improvements in transmission facilities, have been made entirely out of earnings. Engineering and construction have been handled by employees of the Board which, combined with careful purchasing, has kept capital cost down. The light department has no major liabilities and a surplus of over $287,000. Incidentally, this is one case where a municipal utility pays local taxes: the plant is situated in another township and so the Board must pay rates on assessed value of generating plant.

Credit for sound operation of this cooperative enterprise goes to the Superintendent, H W Perry, and to the members of the Municipal Board, who have given time and thought unselfishly: H Allen Wagener, H Merton Smith, Fred C Whitaker, Edwin J Walker Jr, and Charles A Kelly.



Underfeed stokers fire cross-drum, straight-tube boilers in spacious boiler room



A 125-hp squirrel-cage motor connected by a 13-strand multiple V-belt to a line shaft from which flour-milling machines are driven by flat belts

Overload Factors for Multiple V-Belts

Field experience has shown that the overload factor for multiple V-belts should be between 1 and 1.5 for most types of equipment

By F L IVES
Engineer, Allis-Chalmers Mfg Co

Overload Factors for Multiple V-Belts

Type of Equipment	*Overload Factor*
Crushing machinery	1.5
Reciprocating pumps	1.35
Paper-making machines	1.50
Oil-field machinery	1.50
Brick-making machinery	1.50
Textile machines	1.25
Air and ammonia compressors	1.25
Centrifugal fans and blowers	1.30
Centrifugal pumps	1.30
Metal-working machines	1.30
Wood-working machines	1.30

THE VITAL QUESTION in selecting power-transmission drives or even a prime mover is: What shall we use for an overload factor? Every operator and engineer knows that at times machines are subjected to loads much higher than rated value, loads that may be high enough to cause belts to slip or fuses to blow.

A belt should not be used as a safety device and must have sufficient capacity to handle all starting loads. Across-the-line-start squirrel-cage motors develop severe starting loads; starting torque of these motors may vary from about 150% of full load value for normal-torque motors to 400% for high-torque designs. Pull-out torques will also vary over a somewhat similar range. It should be kept in mind that full-voltage-starting torque and pull-out torque of any squirrel-cage motor varies with the synchronous speed of the motor, being highest for high-speed motors and lowest for low-speed designs.

When machines are driven by internal-combustion engines, the load factor need not be greater than the full-load rating of the engine as there is no overload capacity except energy stored in the flywheel, which depends on flywheel weight.

Machines driven from a line shaft have full power of the prime mover to draw from. Prime-mover capacity is considerably in excess of machine requirements and could easily rupture the drive or even the machine. In this case, means should be provided to protect the machine other than dependence upon belt slip.

It Takes Judgment

To determine overloads, based on the driven machine requires considerable engineering judgment. A lathe can take deep cuts in soft material or fast cuts in hard material, depending on type of tool used. A fast feed may stall the machine. Hammer mills are frequently driven above recommended speed to increase their capacity. This is not only a dangerous practice, but it is quite a problem to design a proper drive to carry the load. It is easy to choke a hammer mill by crowding the feed.

The best procedure with multiple V-belts is to locate a similar installation and obtain load readings on the motor. It will then be possible to figure a drive that will handle all loads. In case no information is obtainable, it is best to figure an overload capacity of at least 25% for starting. This will handle most of the overloads. Overload allowance is not penalizing the user, as such a drive will give additional life under proper operation and provide protection against shut down.

The greatest injury to a multiple V-belt can occur on starting. If the drive does not have sufficient capacity, the driving sheave may slip and burn a section on the belt and cause it to eventually break. This occurs quite often when the motor is equipped with remote control starters of high acceleration. Overload factors given in the table are based on the experience of the author in the field. To obtain the horsepower capacity on which to base selection of the belt, multiply motor horsepower by overload factor.

ASME Tackles Tops, Furnaces, Condensers

Despite hurricane and tidal wave, greatest disaster of its 300-year history, Providence, R. I., carries Fall Meeting through without a hitch

WITH skies blue, principal streets clean and dry, and chins up, Providence, Rhode Island, opened the Fall Meeting of the ASME on Oct 5 in the Providence Biltmore Hotel and smoothly carried through three days of scheduled technical sessions, plant visits and sightseeing tours.

Yet on the afternoon of Sept 21, just 14 days before, this same Biltmore stood eight feet deep in salt water as the hurricane drove the Atlantic up Narragansett Bay in a great tidal wave that swept through the heart of the business district. It was the greatest disaster since Roger Williams founded the city in 1636.

In the tiny state of Rhode Island no bigger than a Texas county, 284 people lost their lives. Down along the ocean front, a few miles from Providence, long stretches of shoreline were swept clean of all habitations in a few minutes—nothing left but sand.

Although little of all this havoc and suffering was evident at the Biltmore on Oct 5, a short walk to nearby department stores revealed plenty of unbailed mud in cellars and elevator shafts behind a front of "business as usual". The harbor was still full of floating planks and timbers, and its shores lined with grounded ships and barges. Two great barges sat high and dry in a factory yard, slam up against a brick wall. All through the city and suburbs fine old shade trees were down, part of the wide swath the wind cut all the way from Long Island to Canada. All New England was hit, but Rhode Island the worst, by far.

In spite of this tragic background, all was calm and orderly at ASME meeting headquarters. Everybody—notably the Rhode Island engineering hosts and managers of the meeting—carried on as usual.

Fuels and Power had four sessions in all. Others were devoted to machine-shop practice, rubber, jewelry manufacture, industrial instruments, textiles, management—all subjects of particular interest to this highly industrialized area.

Power and fuels papers covered "tops", pulverizers, furnaces, operating slants on condensers and condenser tubes, industrial evaporators. Plants inspected on scheduled trips included Brown and Sharpe, U. S. Rubber Products, Gorham Mfg, Esmond Mills (textiles) General Electric Co, Narragansett Brewery. Other featured events: general luncheon on the first day, sightseeing trips in Providence and Newport for the ladies, a full-fledged Rhode Island clambake at the Pomham Club.

Design of the new "topping" unit for L Street Station, Boston, was outlined by George A Orrok, Jr, Edison Elec Illuminating Co. The old plant had 198,000 kw in two steam-pressure groups—96,000 kw at 200-lb (48 obsolete boilers supplying vertical turbines) and 102,000 kw at 300 lb and 625 F. The 300-lb turbines were good for years of additional operation, but the boilers not sufficiently modern to justify regular operation.

The topping installation, now nearing completion, will superpose a 1200-lb, 910-F turbine upon the 300-lb units, primarily. Top turbine capacity is about 25,000 kw over 300 lb and 30,000 kw over 200 lb.

Preliminary analysis showed that a straight condensing addition would cost $88 per added net kw, whereas a top would cost $133. But when the capitalized fuels savings were subtracted, the net kw cost figured $22 for the top and about $46 for straight condensing.

The new boiler will be fired by pulverized coal, with oil-burner standby.

On Sept 21, the ocean rose 8 ft over the sidewalk in front of the Providence Biltmore Hotel. Oct 3, all was clean and dry for the ASME meeting (Am-Pro Photo)

The plant is equipped with regenerative air heater, electrostatic dust precipitator, complete pneumatic ash-handling system, multiple-lead damper control of superheat. Fans are driven by constant-speed 2300-volt motors with hydraulic couplings on the induced-draft units and vane control on the forced draft. Jackson & Moreland were the consulting engineers.

In a paper on "discharge temperatures from pulverizers", Ollison Craig, Engineering Manager of Riley Stoker Corp, presented experimental data on temperatures of air entering pulverizers and leaving in the coal discharge. These were related to such factors as moistures of raw coal entering and of coal discharged and amount of coal pulverized per hour.

Warm air, Mr Craig pointed out, increases mill capacity and fineness, and reduces power requirements. But any design must consider the other factors. For example, to avoid explosions the velocity of flame propogation in the discharge line must always be less than the delivery velocity of the mixture of primary air and pulverized coal. Mr Craig compared various sources of heat for pulverizers, such as air-preheater ducts, independent steam-heated air heaters, hot gases drawn from breeching or hot gases from furnace, the latter tempered with air before use.

Men and Machines

Speakers at the general luncheon, with ASME president Harvey N Davis presiding, included Providence Mayor James E Dunne and Dr Henry M Wriston, president of Brown University, who delivered the principal address.

Speaking as a historian and student of social progress, Dr Wriston assailed, as without foundation either in history or in common sense, the twin ideas that technical progress is near the end of its rope and that technology, through unemployment and general complication of life, will undo the men who created it. Both ideas, he said, have been expressed on and off for hundreds of years and repeatedly disproved by subsequent events. The machine, Dr Wriston declared, has made the socalled "poor man" of today incredibly rich in comparison with the average man of premachine ages.

The engineer, he concluded, can neither create nor destroy civilization. He merely gives men efficient tools to use as they see fit. Their use of these tools will depend not on engineering, but on such basic human characteristics as good will, imagination and courage.

Why Furnaces Get That Way

A paper written by Ralph D Booth of Jackson and Moreland, consulting engineers, attempted to determine basic relations in furnace design by analyzing a large number of recent installations along the Eastern seaboard. After making an elaborate study, Mr Booth stated quite frankly that there seem to be few general relations of value. The units studied included 41 bent-tube boilers, 4 straight-tube. Pulverized coal was used in 34, stokers in 5 and oil and gas in 11. The majority of installations were industrial. Heat release per cu ft hour ran from 19,700 Btu to 36,800, with no readily observable relation with boiler capacity. The majority worked between 23,000 and 27,000. There seemed to be no relation between heat release, ash-fusion temperature and ratio of water-cooled surface to furnace volume.

In the discussion, Mr Colby of Combustion Engineering agreed that it is practically impossible to discover useful general relation of the sort sought. Furnace design involves many factors. About all the user can do is to lay before the boiler manufacturer a clear statement of his local fuels, conditions and requirements and let the builder design a boiler and furnace to suit them.

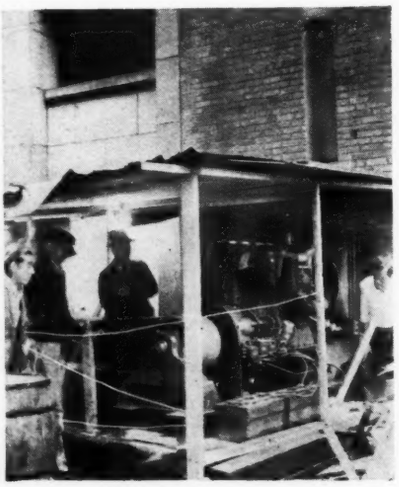
Condenser Practice

A session on condensers featured three intensely practical papers. A J German, chief engineer, Scovill Mfg Co, Waterbury, Conn., presented case studies showing how design and mechanical features of operation affect tube life. James H Harlow and R A Bowman, Philadelphia Electric, showed how reducing tube surface may improve vacuum. H K Nason and J D Fleming, Monsanto Chemical Co, reviewed results obtained with a new chemical used to prevent slime and algae in closed circulating systems, including those used in refrigeration and air cooling.

Cavitation Plus Air

By numerous practical examples, Mr German demonstrated that dissolved air plus cavitation, or its equivalent, is responsible for most pitting, erosion and failure of condenser tubes. Wherever the design or construction causes the water flow to lose contact with the tube, air is released and destruction starts, just as at the trailing end of a marine propeller. That is why tube trouble is generally concentrated at specific zones.

Turbulent flow of water through water boxes may cause much trouble, said Mr German. Inlet tube ferrule should be in close contact with tube end to avoid a turbulence pocket; expansion allowance can be provided at other end.



A Cummins diesel, connected to a 75-kw. ac generator, supplies emergency power to Union Trust Co building, Providence.

Among the many possible sources of excessive air in water are leaks on suction side of pump or improper submergence of inlet bell. (*Power* plans to publish a substantial abstract of Mr German's paper in the near future—Editor)

Messrs Harlow and Bowman gave "before and after" data on an old condenser "laned" for steam flow by removing about 20% of the tubes. Vacuum improvement ranged from about 0.2 in. Hg at 10,000 kw to 0.4 in. at 30,000 kw. About half of this gain came from the laning; the other half from new tubes.

For new condensers Mr Bowman suggested a welded shell with double volute so that steam feeds in toward the center of the tube bundle from all sides. This makes laning unnecessary, he said.

Pentachlorophenate vs Algae

To avoid the complications of chlorine feed in small recirculation cooling-water systems, Monsanto Chemical Co has conducted extensive field experiments with various soluble organic compounds. The aim was to find a substance highly toxic to practically all varieties of slime, not dangerous to man or animals, non-corrosive, cheap and easily fed. According to Messrs Nason and Fleming, sodium pentachlorophenate meets all these requirements. It is intended only for recirculating systems, particularly those used for air conditioning and refrigeration. Constant maintenance of 10 ppm is generally sufficient to prevent all slime. No feeding equipment is required. Chemical cost is said to be very low—$5.00 per year for a 55-ton Freon system.

The great industrial evaporator installations at Firestone Tire and Rubber, Akron, and at Ford Motor Co, Dearborn, were discussed in papers by W K Adkins and W W Dulmage of the respective organizations. In both plants the evaporators receive the exhaust of high-pressure turbines at 240 lb approximately, and supply vapor to process to avoid contaminating the high-pressure boiler feed with returns or makeup. The papers described design details and gave considerable attention to the problems of carryover and of chemically treating the evaporator feed.

Rhode Island Clambake

The Rhode Island Clambake at the Pomham Club drew a big turnout, including many prominent citizens of Providence. ASME President Davis reminisced about this, his home town. Speaking of education, he predicted that the future managers of industry, including the top management, will come largely from engineering graduates.

Principal speaker was Louis Johnson, Assistant Secretary of War. He told how the Army and the CCC had cooperated with the Red Cross in New England after the hurricane. He said that more than 10,000 industrial plants had been earmarked to produce military supplies in case of war.

Engineers' Bookshelf

Fluid Mechanics

FLUID MECHANICS FOR HYDRAULIC ENGINEERS (1938). *By Hunter Rouse, Assistant Professor of Fluid Mechanics, California Institute of Technology, Cooperative Research Laboratory, Soil Conservation Service, Pasadena, Calif. Published by McGraw-Hill Book Co, 330 W 42nd St, New York, N. Y. 422 pages, 6x9 in., 245 illustrations, 6 tables, cloth binding. Price $5.00.*

Intended for graduate students, practicing engineers and laboratory investigators, this book presents in systematic detail the fundamental principles of fluid motion and their application to various phases of hydraulic engineering. Emphasis is placed upon sound physical analysis of actual flow phenomena, in an effort to provide more dependable methods of approach than empirical hydraulics can afford.

The work is divided into five sections: Dimensional Analysis, Fundamentals of Hydromechanics, Mechanics of Fluid Resistance, Mechanics of Wave Motion, and Physical Properties of Common Fluids.

Even though the book is written for the theoretical minded student and engineer, the practical thinker will find much of interest in its pages, particularly in the many photographs taken of flow around obstructions, over weirs and through orifices. Probably never before has there been such a large collection of these photos brought together, showing what happens to liquid flow under such a wide range of conditions. These photographs and the mathematical analysis accompanying them should lead to a better understanding of many hydraulic problems.

Dam Design

"TALSPERREN—STAUDAEMME UND STAUMAUERN." *By Dr Ing Friedrich Toelke, Professor of the Technical University in Berlin (Germany). The title translated would read, "Dams—Nonmasonry and Masonry," a book of 734 pages with 1189 figures and represents the second half of the first part, Ninth Volume of the "Handbibliothek for Bauingenieure" (Reference Library for Civil Engineers) that is being published by Julius Springer, Berlin (1938).*

Beginning with the general description of the different use of dams and the purpose of raising water behind dams, the work of preliminary investigation including the geology of dam sites is discussed. The following chapters treat the rockfill and earth dams, gravity, arched gravity and arch dams, various kinds of buttress and hammerhead dams. The control of concrete, placing and testing of concrete are dealt with as well as measurements on dams and dam models of different kinds.

The author attempts to bring together the European and American practice and experience and gives considerable attention to the mathematical treatment of stress problems. A comprehensive and systematized review of past and present status of dam design and construction without any attempt to introduce the latest viewpoints and their possible influence on future design of dams.

Internal-Combustion Engines

AUTOGRAPHIC INDICATORS FOR INTERNAL COMBUSTION ENGINES (1st Edition—1938). *By J Okill, University of Liverpool. Published by Edward Arnold & Co, London, England. 88 pages, 5x7 in., 62 illustrations, cloth binding. Price $1.80.*

Beginning with the history of indicating devices, the author presents a comprehensive discussion of indicator construction, operation and testing. Particular attention is given to factors which may affect the accuracy of indicated results and also to the use of indicators for securing useful data other than conventional PV diagrams.

Motor Fuels

PRINCIPLES OF MOTOR FUEL PREPARATION AND APPLICATION (Vol. 1, 2nd Edition—1938). *By Alfred W Nash and Donald A Howes. Published by John Wiley & Sons, Inc, 440 4th Ave, New York, N. Y. 628 pages, 6x9½ in., 173 illustrations, 127 tables, cloth binding. Price $9.50.*

This second edition of a standard text on petroleum technology includes a new chapter on pyrolysis and polymerisation and numerous additions and alterations have been made in other chapters to cover rapid advance in the field. The second volume is now undergoing revision and will be available soon.

Mathematics

ADVANCED MATHEMATICS FOR ENGINEERS (1938). *By H W Reddick and F H Miller. Published by John Wiley & Sons, 440 4th Ave, New York, N. Y. 473 pages, 6x9 in., 130 illustrations. Price $4.*

A collection of mathematical facts and theory specifically applicable to engineering problems, this text is suited to advanced college courses or home study by engineering graduates well grounded in calculus. Among subjects covered are differential equations, hyperbolic functions, Gamma and Bessel functions, vector analysis, probability equations and operational calculus. Each chapter is accompanied by a number of practical problems (answers given) which serve to demonstrate application of theory.

Economics

PRINCIPLES OF ENGINEERING ECONOMY (Revised 1938). *By Eugene L Grant, Associate Professor of Economics of Engineering, Stanford University. Published by Ronald Press, 15 E 26 St, New York, N. Y. 430 pages, 5½x8 in., charts and tables. Price $3.75.*

How to find the answer to the question "will it pay?", revised after a study of common errors in engineers' thinking. This book would render a valuable service if it taught only how to avoid mistakes in spending money. But it does more, presenting the machinery for "getting the most for your money in the long run." For a difficult and sometimes abstract subject, the language is simple and direct, well illustrated by case problems. A book that should be within reach of everyone who has to decide when and how to spend money.

Power at Sea

IN HAZARD. *A novel by Richard Hughes, author of "The Innocent Voyage" and "A High Wind in Jamaica." Published by Harper & Brothers, New York, N. Y. Price $2.50. Cloth binding, 6x8 in., 279 pages, no illustrations.*

For *Power* to review a novel is almost unprecedented, but many readers will thank us for the tip that "In Hazard" holds a double interest for them. First, it is one of the greatest tales of the sea ever written, deservedly ranked with Conrad's "Typhoon." Second, it deals with steam, not sails; the "Archimedes," pounded for days by a tremendous hurricane, was a 9000-ton turbine ship. Naturally Chief Engineer McDonald, his engine room force, and his oil-fired boilers play a major part in the story.

While author Hughes is presumably not an engineer, he is a keen scientific observer and shows a very fair knowledge of what goes on in the stoke hold, as well as on the bridge. Here is a book worth the attention of any red-blooded man, of any engineer and particularly of any marine engineer or ex-marine engineer. Many *Power* readers have served terms at sea. They will like this book.

Air Conditioning

AIR CONDITIONING FOR COMFORT (3rd Edition—1938). *By Samuel R Lewis, consulting mechanical engineer. Published by Keeney Publishing Co, 6 N Michigan Ave, Chicago, Ill. 285 pages, 6x9 in., 105 illustrations, 27 tables, cloth bound. Price $2.50.*

Revised and enlarged edition embodies the experience resulting from use of two earlier editions in practice and by students. The book is divided into these

(*Continued on page* 128)

Current Comment

Who's an Engineer

AFTER READING so much about who is and who isn't an engineer, I'm asking if this question can be answered for me: "Am I an engineer of any class, rank or degree?"

I have worked for 13 years in a power plant—for three years in a large central station as ash dumper, fireman and water tender and for the past ten as operating engineer in charge of one shift in an industrial plant.

My education did not go beyond the seventh grade, but since I started to work in a power plant, I have continuously studied the technical side of my work—mathematics, steam and combustion, and some electricity. I'm able to get to the bottom of any steam or combustion problem in my work.

I have no engineering license because the two southern states in which I have worked do not require one. Am I an engineer?

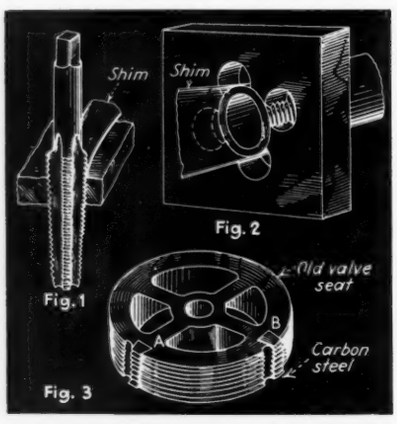
XYZ Plant JOHN DOE

[*Editor's Note—For obvious reasons, the writer has asked his name and connection withheld, but the letter and the problem are real. The editors have their own ideas on this matter, but feel that readers should have a chance to express their viewpoints.*

Within space limitations, POWER *will welcome brief answers to this question.*]

Cuts Threads with Improvised Tools

IN THE JUNE number of *Power* M T Pate refers to grinding a drill off center to bore an oversize hole, which reminds me of a scheme I have used many times for tapping oversized holes and for threading undersized bolts or pipe by shimming a tap (Fig. 1), or a die (Fig. 2). Simply place a copper or soft-iron shim in the hole that has previously been tapped and run the tap down. The shim may cover one or two of the cutting lands. Amount of oversize obtained will be governed by the thickness and number of shims, but is small in any case. The shims of soft metal confirm to the threads and do not injure them. Fig. 3 shows an improvised die for recutting threads in a pump-valve deck before replacing valve seats where the threads have been damaged. Two sections, *A* and *B*, of annealed carbon steel are inserted in an old valve seat as shown, with flutes ground in front of the inserts. A piece of old file that has been annealed can be used for the inserts. File or grind off the two lower threads from the seat. Carefully file the thread-cutting die into the steel to correspond with the threads of the seat, then heat to a cherry red and submerge in oil to temper the steel.



A piece of pipe may be notched in the end to fit into the seat to provide a handle and a bolt screwed into the center of the seat to hold the pipe and seat together. This device can be used as a regular tap, and if the job is made up correctly, it will rethread the old openings satisfactorily for replacing new seats.

Evansville, Ind. C B RISLEY

"Royal Road"

THE EDITORIAL "Royal Road", September *Power*, is most interesting. Some teachers seem to delight in creating a mystery about this process called education. I believe education to be of two types: (1) theoretical, knowledge for knowledge's sake and (2) practical, enough theory to properly understand the why and how of the problem so that one may appreciate the limitations of application.

The first type usually leads to the extreme specialist who learns more and more about less and less, while the second type generally is the education possessed by the people who do things in the work-a-day world. Each type of training has its place and each needs the other, but it is the *application* of principles that creates productive results.

I hope that you follow up your line of thought in future numbers of *Power*.

Chicago, Ill. FREDERICK OAKHILL

MAY I ADD my word of thanks to the host you should receive for the editorial "Royal Road". I hope some day you will find a man who can present higher mathematics as clearly as the writer's thoughts were expressed in the editorial.

I do not know of any greater contribution McGraw-Hill could make toward the removal of barriers to scientific learning than to find a man or a group of men who could apply the "paint remover" successfully.

As a constructive suggestion, why don't you appeal to your readers to give you the benefit of their experiences? They might solve the problem if you could get them to tell how they brought individual subjects down to earth and grasped them for application on their daily jobs. I shall be glad to have you use me for a guinea pig if you can find any suitable material on higher mathematics.

Bakersfield, Calif. A V WHITFIELD

THE GOOD SENSE of your editorial "Royal Road" in September *Power* calls forth a testimonial. Unlike the professor who set 2 x 2 on his slide rule, read 3.9 and said "call it 4," after many years of study I have adopted your method of real short cuts. I chased X^3—Y^2 four years to find the factors and threw away the geometry book after the first chapter of kindergarten confusion. From 20 years collection and 3 years editing I compiled myself a little book of 36 pages which covers 90% of requirements in my business, as you suggest in your "Royal Road". It saves carrying around a library of about 100 books for the few widely distributed requirements.

Washington, D. C. J C RUNYON

"ROYAL ROAD" deals with an important and very timely subject. Any virtue, practiced to excess, becomes a vice. Education, especially the kind of thing which generally goes by that name, is no exception.

It might be a good thing if we gave up the practice of handing out degrees and telling people that they have an education. I don't really expect that we shall do anything of the sort, but it would have some quite definite advantages.

Why do we persist in telling these young men that they have graduated, that they have finished something, when as a matter of fact they have only just begun. If the course were forty years instead of four, they might have found out by that time that they never could really graduate in anything.

I agree that the emphasis on degrees and graduations often has a very discouraging effect upon the practical man who has not attended a technical school, and he needs all the encouragement we can give him.

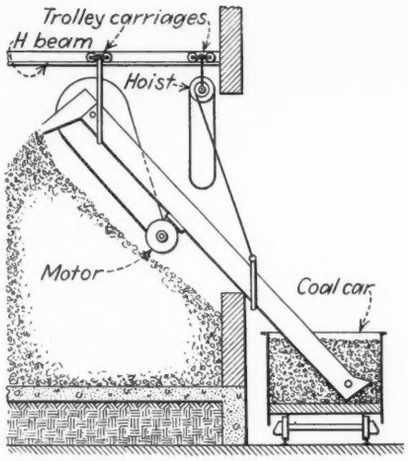
There is too often a mutual tendency for practical men and theoretical men to distrust each other. Both are at fault. The practical man who despises technical education is generally quite hopeless. On the other hand, the young man who prides himself upon the little theoretical knowledge that he has, is generally a good deal of a headache.

As Heine said, "Experience is a great teacher, but his charges are very high". Experience is something which life will not let any of us escape, so the theoretical man will probably turn out all right in the end. He will have to pay for it, and so will the practical man if he seriously tries to gain theoretical knowledge.

Bloomfield, N. J. J O G GIBBONS

Homemade Coal Unloader

IN AUGUST *Power*, "Practical Aids to Operation," O Hopsch describes a homemade portable conveyor designed to min-



imize shoveling when loading coal into trucks. Loaders of this type whether homemade or purchased can often be used to overcome many fuel- and ash-handling problems. During a recent visit to a small industrial plant I ran across a particularly novel example of this adaptability. In this case, a portable loader was arranged so that coal could be elevated from the gondolas in which it was received into a storage room having a filling opening several feet higher than the car sides.

As shown in the figure, the loader with wheels and axle removed is suspended from trolleys that travel on an H-beam hung from the storage-bin ceiling. At its upper end the conveyor assembly is fastened to its carriage by a bracket supporting a section of shafting that passes through bearings bolted on the bottom of the trough. A similar bracket placed on the lower side of the center of gravity of the loader is supported from a separate trolley carriage with a light-weight chain hoist. Current is supplied to the conveyor motor by a flexible cable dropped from an outlet in the ceiling. When the assembly is rolled out to the limit of its travel and the hoist chain extended, the conveyor slides down into the car. In like manner, taking up on the chain raises the assembly so that it can be pushed back under cover when not in use.

This conveyor, in addition to overcoming a condition where handling coal by hand was difficult, has low first cost. Track hoppers and the usual horizontal and vertical conveyors could not have been economically justified because of the comparatively small quantities of coal handled. Another valuable consideration is the ease and speed of raising and lowering the conveyor.

Roanoke, Va. S H COLEMAN

More About "What Happened"

IN THE CASE described by M H Kuhner in September *Power*, I think that the feedwater heaters gradually went out of service for some cause. Lowering the feed temperature will increase the superheat, but requires more fuel to maintain the same evaporation. The design of this boiler would cause more heat to be absorbed in the economizer section if cold water were fed to it, which would tend to maintain the exit gas at about the same temperature.

The only variable would be fuel, which would have to be increased. The problem states no changes in operation were made, which I am inclined to doubt as there are no charts to prove this, nor the feedwater temperature.

Victoria, Texas W F SHUTT
Central Power and Light Co

More Steam from Wood Waste

AN INTERESTING series of questions on the article "More Steam from Wood Waste" in *Power*, March, 1938, was received some time ago from C A Crytser of Huntington Park, Calif., and was forwarded to the author, G C Desler, for reply. For the benefit of readers interested in burning waste fuels, the questions and answers are printed below:

1. Does the writer refer to the inlet ducts in the side walls and center wall as "air-cooled walls"? Is the front wall air cooled? If so, where is the air discharged?

Inlet ducts in center and side walls do not ventilate combustion chamber walls. The front walls are not ventilated but can be, and this has been done on other installations.

2. Is there any trouble with slagging over the points of air entrance to the furnace?

There is some slagging of air ports at point of entrance to the furnace, but slag is easily removed.

3. It appears that cast-iron chutes are used without provision to limit flow of excess air to furnaces. Do these chutes warp and distort? Does air entering with fuel cause trouble by cooling this section of the arch?

A balanced swinging gate is provided to limit excess air flow into furnace; cast-iron fuel chutes do not warp; no trouble with cooling of arch.

4. I have found that admission of secondary air under gas flow through the bridgewall gives the best mixture. It would appear to me that admission through the nose of the arch as shown would cause stratification, and if combustion were complete at all, it would take place in the tube banks or in the second pass. Might I ask if any explosion of gas ever takes place within the setting and also if any Orsat analyses have been made to determine CO_2 content of outlet gases?

Experience proves that air must be admitted through nose of arch; CO_2 shows a good combustion; mixture is nearly complete; bridgewall may last two years, center wall about one year; there is no sign of stratification on the nose of the arch; combustion takes place in the combustion chamber; secondary air drives gases to bottom or lower end of first bank of tubes; gas explosions have never taken place in the setting; no Orsat analyses of outlet gas were made.

5. At the time proposals were made was any consideration given to changing boiler baffling to reduce pressure drop through the unit so forced draft would have been unnecessary? My experience includes one job where it was possible to eliminate forced draft after it had been used many years. How noisy are the blowers? Is it possible to carry on a conversation in the boiler room?

Baffling was slightly altered, but not with intention of eliminating forced draft, which is necessary to burn wet and green hog fuel fast enough to generate steam at 200-300% rating. Steam turbine blowers are not noisy, being large to avoid excessive speed. Conversation can be carried on at all times in the boiler room.

Why Galvanize Inside of Iron Pipe?

GALVANIZED water pipe has decided advantages when the zinc coating is applied to the outside of the pipe. But does internal galvanizing really prolong the life of a water pipe? I'm afraid not. Internal galvanizing has been done for many years, yet I still say that I'm afraid not. Why? Because zinc has a strong attraction for iron that is dissolved in water, and there is plenty of it dissolved from the walls of the pipe in our city-water systems. The zinc on the inside of the pipe draws iron from the water, and deposits it on the walls, gradually closing up the pipe.

This is only the beginning of our troubles. In city-water systems, water is treated with chlorine gas. Chlorine unites with water to form hydrochloric acid which attacks the zinc-coating on the inside of the pipe, and it doesn't last long. In fact, zinc-coating on pipes does mighty well to last two months in some cities.

Water containing dissolved limestone, as found in certain sections, present another problem. The metallic calcium is attracted to the zinc and gradually closes the pipe. Here again we have the beginning of a fast-growing corrosion. It makes no difference if hot or cold water flows through the pipes—we get into the same troubles. The hotter the water, the faster the pipes will become clogged and thin-walled. There are those who believe that a ring of corrosion in a pipe protects it from getting thin-walled. I wish this were true, but it is not. The pipe that is the most corroded is the one most likely to leak. Scale is tough, but it has not the strength of iron pipe. Therefore we cannot substitute scale of corrosion for the pipe wall.

Zinc is easily oxidized. That means that zinc quickly unites with oxygen in the water flowing through the pipe. So zinc coating doesn't last very long, and zinc actually induces corrosion. Omitting galvanizing on the inside of the pipe would reduce the cost to both pipe manufacturer and consumer in addition to the fact that the pipe would have a much longer life.

Llanerch, Pa. ERWIN J DAVIS

Power Men Fight Wind and Sea

The hurricane that struck the Atlantic Seaboard on Wednesday, Sept 21, tested the mettle of New England's power men. Quick thinking and fast action by this chief engineer allowed only temporary outage at a Massachusetts utility plant. His letter to a friend in Boston was written on Sept 30, when impressions were still vivid

Dear Tom:

On Wednesday the 21st I had just returned from lunch about 1:40 pm. We noted the barometer falling and a very high SE wind, gradually increasing; everyone around seemed to be worrying.

The first thing we did at the plant was to run over two unloading coal towers (a Mead Morrison 2-ton and a Maine Electric 1 1/5 ton) up until they touched each other. We then put some chains around the two legs and chained the wheels down to the tracks. This act no doubt saved one or both of our towers. Our reclining gantry bridge started to run up the track to the west, so this was blocked from moving any farther; the moving of this bridge was very good for us, as the tracks on the south side washed out and sank out of line just where the bridge had been.

The water kept rising, the stacks appeared to be swaying (thank goodness they were thoroughly repaired a year ago). The water kept on coming, bringing boats, lumber, parts of houses, etc, into the yard. By 5:40 pm, water had reached the station and was coming in all doors, shooting up about a foot high through every floor drain, and all the standard size manholes leading into our air and water intake and overboard tunnels lifted up and moved over on the floor. All men operating on this floor were given lifelines, as we did not know where the manholes were.

Our condensate pumps are located in pits 4 ft deep under the condensers. Hence motors were submerged, so they were tripped off and the turbine-driven pumps put on and these ran under water until about 6:30 pm.

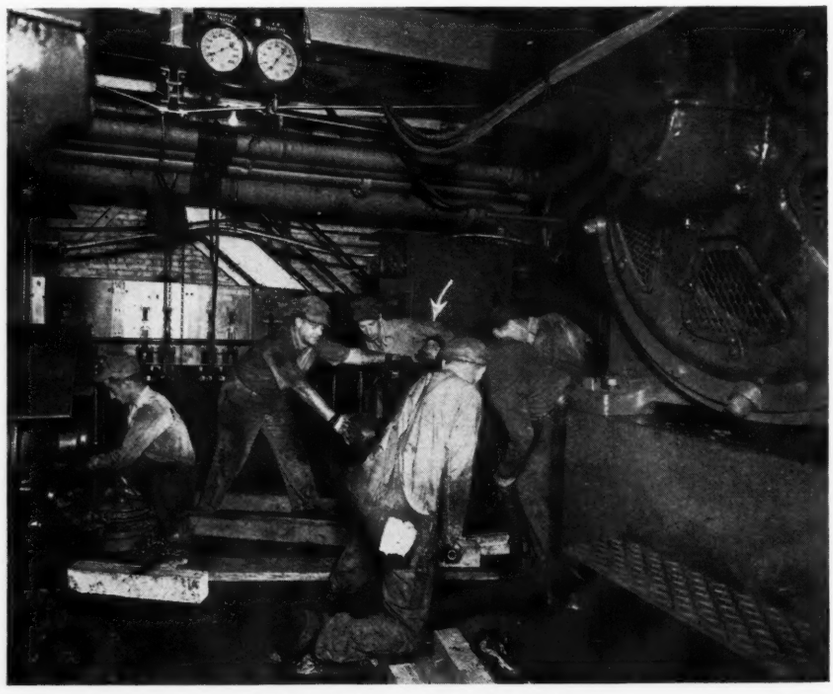
All motors on auxiliaries close to water level were tripped off; exciters on dual drives were tripped over on steam ends. At 6:03 pm water reached within ½ in. of bottom field coils on exciters, and water had entered the conduit lines of 13,200-volt lines from the generators. We dared not run any longer. Station was shut down at 6:03 pm. We used flashlights, searchlights, etc, keeping the storage batteries for switch operation.

Our station has three 2300-volt generators tying our 2300- and 13,200-volt systems together with transformers. We instantly decided to start one of these generators first. The water was now receding. We hooked up a 2½-in. steam syphon and followed the water down; we also started four other syphons that are permanently installed in our air tunnels.

One air compressor with motor was above high-water mark. We started one 2300-volt turbine unit with steam auxiliaries at 7:45 pm, giving station lights at 8 pm and then started air compressor, blew out the three duct lines on generator to get rid of any water there. The 2300-volt bus was now alive; all field-rheostat remote controls had to be worked by hand as these were all grounded.

The fire chief gave orders that no outside lines were to be closed until he released them, so at approximately 9:30 pm the first line was released and closed, giving the hospital and the west end of city light wherever lines were clear.

The electric service company in town was notified by sending a man there. Also called in all spare men who could get here and by midnight we were



HIGH WATER AT HELL GATE

A huge wave whipped by the hurricane that swept the Atlantic Seaboard on September 21, suddenly flooded the Hell Gate Station of Consolidated Edison Co of N. Y. Water rose to the point shown by the arrow, drowning out motors and other auxiliaries. Crews are shown removing equipment, cleaning and reconditioning it for service

pulling out motors so they could be dried out by the service company. Thursday morning (the 22nd) our motors were the first in the oven. These motors were taken apart here at the plant and thoroughly washed out with fresh water and compressed air, then reassembled and sent to the shop for drying out.

The second 2300-volt generator was put on the line at 5:55 am Thursday. Because lines, poles, etc, were down outside, there was not much more than 5000 kw load Thursday forenoon, so we were able to spend time blowing out conduits for leads from 13,200-volt generators to bus. The five 13,200-volt generators were then each started, brought up to speed and gradually excited, and the potential very slowly brought up to 13,200 volts. Kept them there for half an hour, and the 13,200-volt bus was made alive from the 2300-volt bus to transformers. Then these five generators were tried out on line, synchronized in regularly so as to be ready when load increased.

We had several tons of coal washed away and considerable damage done to our dock; considerable copper flashing torn from our roof; windows broken, etc, but we had only two motors burned out on the whole system. Everything as far as the station is concerned is practically normal now, except for these two motors. I have all the copper flashing back on the roof. Put on several extra men Thursday and am discontinuing them today.

We have a steamer in today and are unloading as usual, although our track is 30 ft out of skew to the north. I believe we are one of the first seaboard plants in New England to come back on the line, but I think this mainly due to location, steam auxiliaries, and cooperation of the men who pitched in to help us come back when we did.

The water reached a maximum of 25 in. above our first or ground floor. In condenser pits it was about 7 ft deep. Between Wednesday morning and Sunday morning I had seven hours' sleep at my desk, but then have had three good nights' sleep since then, so what the ——.

Power Lines

Power Show Plans Near Completion

With the 13th National Exposition of Power and Mechanical Engineering less than two months away, exhibitors are speeding their preparations for a large and comprehensive presentation of power-plant and mechanical-engineering equipment. Over 260 manufacturers already have engaged space on three floors of Grand Central Palace, New York, N. Y., where the Exposition will be held during the week of December 5 to 10, 1938.

In the field of refractories and insulation materials, exhibits will offer the following products: insulating cement, rock-wool blankets and blocks, also loose and granulated forms; pipe covering, plastic compositions, fire brick, and asbestos. Suspended air-cooled walls, suspended arches, and solid battery walls also will be demonstrated by means of scale models.

Hose, tubing, and pipeline exhibits will include one featuring a working diorama of a steel mill. Grouped around this attraction will be a complete display of steel products for the power industry. Attention will be drawn to new forms of welded pipe and wire rope. One manufacturer of steel alloy tubing will exhibit a locomotive boiler sheet with tubes rolled in. This type carbon steel is said to have been effective in extending the height of a famous radio station's transmission towers from 200 to 300 ft.

Valves and fittings for every kind of power plant application will be shown at the Exposition. Drop-forged steel pipe fittings, both screw-end and with socket ends, for welding, will be featured by one exhibitor. In addition there will be a wide range of power-plant accessories including high-pressure steam globes, liquid-level controls, float valves, pressure regulators, reducing and relief valves, blowoff units, pipeline separators, boiler-drum separators, throttles, swivel joints, high-speed rotation joints, condensation coils, couplings, steam traps, pump governors and pressure gages.

Among the numerous operating displays will be air and liquid filtering equipment. An automatic aircraft filter will be mounted and operating on the rear section of a Wright Cyclone engine. A working model of an oil filter will demonstrate the removal of carbon black from oil. This same exhibit will emphasize a large pressure filter having 15,496 sq in. of filtering area in a shell 18½ in. OD, 43 in. high. Its maximum capacity of oil is 232 gpm.

Power transmission will be represented by many exhibits. A frictionized belting, which delivers maximum load immediately, and, according to reported transmission tests, maintains that capacity beyond the ordinary "breaking-in" period will be shown. Other complete lines of transmission equipment will include V-belts, round and flat endless belts, belt fasteners, silent and roller chain drives, worm and motorized helical gear reducers, anti-friction pillow blocks, flexible couplings, variable speed units, standard and over-running clutches, speed control units, gears, sprocket wheels, speed reducers, ball and roller bearings.

Many new types and applications of tools and machines will be shown. An innovation in hack saw blades is one which has been hardened on the tooth edge only. Then too, there is the fully automatic saw that works like a screw machine, cutting a bar of steel into blanks without the attention of an operator. Other tool exhibits will be represented by complete lines of equipment which include saw filers, die makers, retoothers, band filers, contour machines, pipe and bolt cutting and threading machines, polishing machines, electric markers and etchers, soldering tools, wire strippers, milling machines, tap grinders, and electric drills.

The 13th National Exposition of Power and Mechanical Engineering, as heretofore, is under the management of the International Exposition Co, Grand Central Palace, New York. Charles F Roth, President, will again be personally in charge.

Meetings

American Society of Heating and Ventilating Engineers—*Annual Meeting, Jan 23–26, William Penn Hotel, Pittsburgh, Pa. A V Hutchinson, secretary, 51 Madison Ave, New York, N. Y.*

American Society of Mechanical Engineers—*Annual meeting, Dec 5–9, New York, N. Y. C E Davies, secretary, 29 W 39th St, New York, N. Y.*

American Society of Refrigerating Engineers—*Annual meeting, Dec 6–8, Hotel Commodore, New York, N. Y. Headquarters office, 37 W 39th St, New York, N. Y.*

National Warm Air Heating and Air Conditioning Assn—*25th anniversary convention, Dec 12–14, Netherland-Plaza Hotel, Cincinnati, Ohio. Allen W Williams, managing director, 50 W Broad St, Columbus, Ohio.*

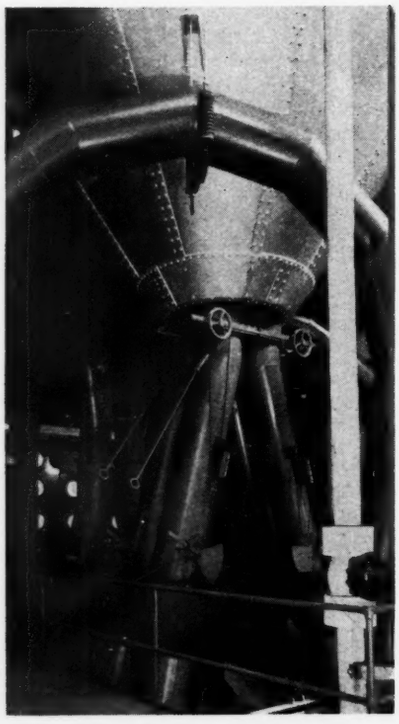
National Exposition of Power and Mechanical Engineering—*Dec 5–10, Grand Central Palace, New York, N. Y. Charles F Roth, manager, International Exposition Co, New York, N. Y.*

Niagara Hudson Turbine

In October *Power*, page 101, there appeared a description of the proposed 80,000-kw central station at Oswego, N. Y., to be built by Central New York Power Corp, subsidiary of Niagara Hudson Power Corp. Through error, the turbine was classified as a 3600-rpm unit; its speed is actually to be 1800 rpm.

Melville Medal to Büchi

Harvey N Davis, president, ASME, presented the Melville Medal to Alfred J. Büchi of Winterthur, Switzerland, at the Sept 26 meeting of the Metropolitan section, sponsored by the Oil and Gas Power Division. Mr. Büchi received the award for his paper "Supercharging of Internal-Combustion Engines with Blowers Driven by Exhaust-Gas Turbines", read at the 1937 Annual Meeting of the Society.



COAL WAYS

'Tain't a giant squid taking a nose dive —merely the lower end of a 180-ton vertical coal bunker with four pipes leading from it, in the new boiler plant of Dominion Steel & Coal Corp, Sydney, Nova Scotia. (For complete description of this new plant, see article on pages 50-53 of this issue.) Each pipe terminates in a funnel so that the boiler operator can see that coal flow to four pulverizers below the operating floor is not interrupted. A meter on each pipe records weight of coal going to each pulverizer.

STRAWS

Pointing the way business winds blow

ALABAMA——Board of Trustees, University of Alabama, Tuscaloosa, Dr Richard Foster, president, plans central-heating plant for new group of buildings to form a medical center at institution. Cost about $2,500,000. Financing being arranged through Federal aid.

ARIZONA——Benson contracted Vinson & Pringle, 919 E Madison St, Phoenix, for installation of municipal natural-gas distributing system, including connection with main line of El Paso Natural Gas Co, for supply. Cost about $35,000. Financing through Federal aid. Headman, Ferguson & Carollo, Homebuilder's Bldg, Phoenix, consulting engineers.

ARKANSAS——E L Bruce Lumber Co, East Little Rock, is considering new boiler house in connection with proposed rebuilding of portion of lumber and planing mill, recently destroyed by fire. Loss about $200,000.

Conway plans improvements in municipal electric plant, including 1000-hp diesel-generator and auxiliaries. Cost about $73,800, of which $32,227 will be a Federal grant.

CALIFORNIA——Imperial Irrigation District, El Centro, plans hydroelectric plant to use water from Federal All-American canal supplementary projects. Cost $1,900,000. A bond issue of $1,045,000 is planned, remainder of fund to be secured through a Federal grant.

Bureau of Yards and Docks, Navy Dept, Washington, D. C., contracted Nordberg Mfg Co at $46,875 for air compressor and accessories for Mare Island Navy Yard.

(*Continued on page* 130)

NEW PLANT CONSTRUCTION

McGraw-Hill Business News Department Is Prepared to Furnish a More Complete Daily Service

Ark., El Dorado—City, c/o A. T. Wright, mayor, defeated bonds constructing brick, concrete light and power plant, power generating equipment and appurtenances and distribution system, etc. $663,000. F. Goolsey, city engr.

Calif., El Centro—Imperial Irrigation Dist. voted $1,045,000 bonds, constructing hydroelectric plant at Drop No. 4, All-American Canal, 2 new units at Brawley plant and 1,000 mi. additional distribution lines. Total est. $1,900,000.

Colo., Lamar—City plans constructing addition to present power plant. $200,000. Burns & McDonnell, 107 West Linwood Blvd., Kansas City, Mo., engrs.

Fla., Sanford—City plans constructing new power plant and distribution system. $300,000. Burns & McDonnell, 107 West Linwood Blvd., Kansas City, Mo., engrs.

Ga., Boston—City Council plans constructing municipal electric power plant, cold storage and refrigeration plant. $225,000. Barrill & Humphreys, Forsyth Bldg., Atlanta, archts.

Ia., Ackley—Bids Oct. 24, by City, furnishing, installing one 225 hp. diesel engine with alternator exciter and auxiliaries and improving municipal electric light plant. To exceed $25,000. R. W. Gearhart, 349 21st St, Cedar Rapids, engr.

Ia., Ames—City, J. H. Ames, city mgr., making plans constructing power plant addition. new 3,000 kw. turbo-generator and auxiliaries, a force draft cooling tower, etc. $170,212. P.W.A. grant $76,600 approved. J. H. Ames, city mgr.

Ia., Cascade—Town voted $60,000 bonds, constructing municipal electric light plant. $109,000. P.W.A. grant $49,500 approved. Write City Clerk, Cascade.

Ia., Mount Pleasant—City, J. P. Budde, clk., soon takes bids constructing steam power plant extension, incl. 1,000 kw. Turbo-generator unit, duct work, condenser, circulating pumps, air ejectors, condensate pump, etc. Young & Stanley, Muscatine, engrs.

Ia., Spencer—City, c/o E. H .Penning, clk., indefinitely postponed constructing improvements to municipal light and power plant building and equipment. $82,600. Burns & McDonnell Eng. Co., 107 West Linwood Blvd., Kansas City, Mo., engrs.

Kan., Neodesha—City, S. G. Hamilton, clk., will not construct municipal light and power plant improvements, incl. one 1,500 hp. turbine, etc. $188,320. Rejected P.W.A. grant $84,744. Black & Veatch, 4706 Bway., Kansas City, Mo., engrs.

Ky., Burkesville—City, election Nov. 8, to vote $65,000 bonds constructing municipal light, heat and power plant.

Mich., Hillsdale—Bids Oct. 21, by City, constructing 55x69 ft. brick, steel power house. Total cost $132,517. P.W.A. project. Hamilton & Weeber, Federal Sq. Bldg., Grand Rapids, engrs.

Mich., Saginaw—City plans constructing new power plant and distribution system. $6,000,000. Burns & McDonnell, 107 West Linwood Blvd., Kansas City, Mo., engrs.

Mich., Wyandotte—City, H. E. Allen, supt., plans constructing brick, steel, rein.-con. addition to power plant and additions to generating equipment for municipal power and lighting plant. $177,750. P.W.A. project.

Minn., Alexandria—Bids Nov. 3, by City, for steam generating unit for power plant. $162,465. P.W.A. project. Burlingame, Hitchcock & Estabrook, 521 Sexton Bldg., Minneapolis, engrs.

Minn., Brainard—City plans constructing municipal light and power plant. $934,000. P.W.A. allotted $420,300 grant. Burlingame, Hitchcock & Estabrook, 521 Sexton Bldg., Minneapolis, engrs.

Minn., Le Center—City plans constructing electric light and power plant, generating equipment, distribution system, etc. $127,000. P.W.A. allotted $57,150 grant. G. M. Orr & Co., 542 Baker Arcade Bldg., Minneapolis, engrs.

Mo., Carrollton—City, c/o O. Brunsworth, mayor, voted $129,250 bonds, constructing brick, concrete light and power plant building, equipment and appurtenances, distribution system, etc. $235,000. P.W.A. allotted $235,000 grant. Burns & McDonnell Eng. Co., 107 West Linwood Blvd., Kansas City, Mo., engrs.

Mo., Eldorado Springs—City, c/o City Clerk, voted $65,000 bonds, and soon takes bids constructing rein.-con., brick, power plant, equipment and appurtenances. $120,000. P.W.A. allotted $54,000 grant. W. P. Rollins & Co., 339 Railway Exch. Bldg., Kansas City, Mo., engrs.

Mo., Kirkwood—City, A. S. Kinyon, mayor, election Oct. 29, to vote $68,000 bonds, constructing municipal light and power plant improvements, incl. substation, new switchboard, regulators, cable, etc. $124,000. J. P. Sparks, city engr.

Mo., Liberty—City plans constructing new power plant and distribution system. $300,000. P.W.A. allotted $148,500 grant. Election Oct. 25, to vote $195,000 bonds for same. W. P. Rollins & Co., Railway Exch. Bldg., Kansas City, Mo., engrs.

Mo., Pleasant Hill—City, c/o J. A. Swift, mayor, soon takes bids constructing brick, concrete power plant building, equipment, accessories and appurtenances, distribution system. $165,000. P.W.A. project. W. B. Rollins & Co., 339 Railway Exch. Bldg., Kansas City, Mo., engrs.

Neb., Fremont—City, c/o Bd. Public Utilities, Fremont, plans constructing power plant improvements, installing switchboard and appurtenances, underground service. transmission lines and substation. $296,489. P.W.A. allotted $126,450 grant. G. Grabe, Fremont, archt. Black & Veatch, 4706 Bway., Kansas City, Mo., consult. engrs.

N. D., Jamestown—State Bd. Administration, Bismarck, plans altering and improving power house equipment. $154,540. P.W.A. allotted $69,543 grant. W. P. Kurke, Fargo, archt.

O., Clyde—City Bd. Trustees, H. J. Whittaker, clk., plans constructing electric light plant addition. $154,436. P.W.A. grant $69,436 approved. Froeligh & Emery Eng. Co., 410 2nd Natl. Bank Bldg., Toledo, engrs.

Okla., Carnegie—City held election Oct. 18 to vote bonds, municipal light plant and distribution system. $64,000. V. V. Long & Co., Colcord Bldg., Oklahoma City, engrs.

Okla., Cherokee—Town, c/o Manager, making plans improving power plant, incl. installing 850 hp. Diesel generator and cooling system. $132,000. P.W.A. grant approved.

Okla., Prague—City voted bonds constructing new municipal light and power plant. $39,000. Holway & Neuffer, 302 East 18th St., Tulsa, engrs.

Okla., Purcell—City takes bids within 30 days constructing power plant, new Diesel generating unit and auxiliaries, regulators. $65,000. Bonds voted. E. T. Archer, 609 New England Bldg., Kansas City, Mo., engrs.

Tex., Baird—City, B. L. Elliott, Jr., secy., voted $165,454 bonds, constructing municipal electric power and light plant. $165,454. P.W.A. loan $91,000 and grant $74,454 approved. A. C. Moore & Co., c/o Builders Exch., San Antonio, engrs.

Tex., Crosbyton—City, C. M. Huddleston, mayor, soon takes bids constructing power plant, 2 diesel generating units, approximately 120 KW each and all appurtenances, switchboard, fireproof power plant building, overhead electric distribution system to operate 3 phase, 2400 volt primary, 60 cycle constant current series street lighting circuit, etc. $94,000. P.W.A. grant $42,637.

Tex., Cuero—City, c/o J. F. Newman, making plans constructing power and light plant, incl. electric generating plant, distribution system and lighting system. P.W.A. allotted $101,000 grant. Garrett Eng. Co., Box 1726 Houston, engrs.

Tex., Fredericksburg—City, E. Krauskopf, mayor, voted $100,000 bonds, constructing municipal power and light plant. $155,000. J. E. Ward, Harvey-Snider Bldg., Wichita Falls, archt.

Tex., Goldthwaite—City, c/o H. G. Bodkin, mayor, plans constructing municipal electric generating plant and distributing system. $120,000. Bond election soon for same. W. G. Morrison, 912 Professional Bldg., Waco, engr.

Tex., Gonzales—City, c/o S. M. Ainsworth, mayor, voted bonds constructing municipal electric power and light plant, transformers, cooling towers, poles, Diesel electric units, etc. $173,000. P.W.A. project. Garrett Eng. Co., Box 1726, Houston, engrs. Electric power to come from LCRA.

Tex., Lampasas—City, c/o R. J. Paine, mayor, voted $100,000 bonds, constructing power plant. W. G. Morrison, 912 Professional bldg., Waco, engr.

Tex., Perryton—City, C. E. Forbes, mayor, voted bonds, constructing power plant building $22,750, generating equipment, 3 units, two 225 hp. and one 375 hp. at $74,000, incl. all auxiliaries and distributing system for entire city $43,000, deep water well, cased, pump, etc. $9,000. E. T. Archer & Co., New England Bldg., Kansas City, Mo.

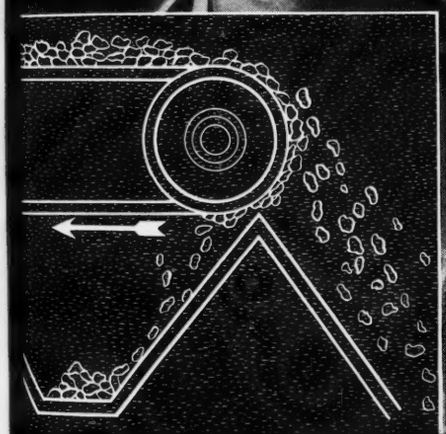
Wis., Knowlton—Consolidated Water Power Co., Inc., of Wisconsin Rapids, making plans constructing power plant. $3,000,000.

Wis., Sheboygan—Sheboygan Co., plans by E. A. Stubenrauch, 809 North 8th St., constructing insane asylum buildings, barns, power house, laundry, etc. $1,060,000. P.W.A. grant $477,000.

B. C., Vancouver—B. C. Electric Railway Co. Ltd., A. C. W. Gage, purch. agt., Vancouver, making plans constructing hydroelectric development. A. Vilstrop, c/o owner, engr.

N. S., Conquerall Mills — Town Council, Bridgewater, plans constructing extension of electric light and power plant. $125,000.

Magnetic Protection



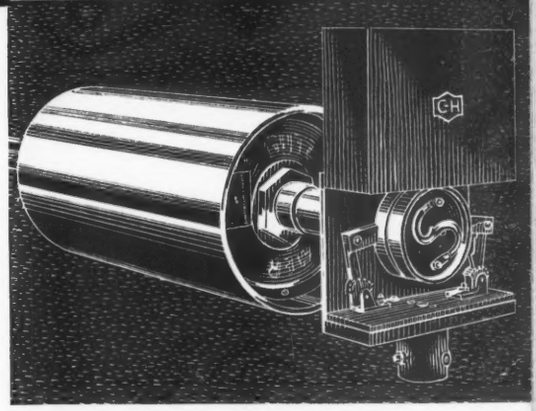
Graphic diagram shows separator operation. As the conveyor belt travels around the pulley, the coal drops off. But iron "sticks" to pulley until the belt, traveling to left, pulls it free whence it drops into recovery box.

All C-H Separators are provided with dust-proof covers on brushes and slip-rings. They require practically no attention and maintenance as proven through 29 years of experience in thousands of installations.

C-H Separators Guard Expensive Material and Equipment Against Breakage and Loss

For many years now, sure protection to costly materials, machines and finished products has been afforded by Cutler-Hammer Magnetic Separators. Designed by the world's leading control specialists, these units positively, unfailingly remove "tramp iron" from coal, from grain, from food products, from sewage and recoverable waste, from a great variety of non-ferrous materials.

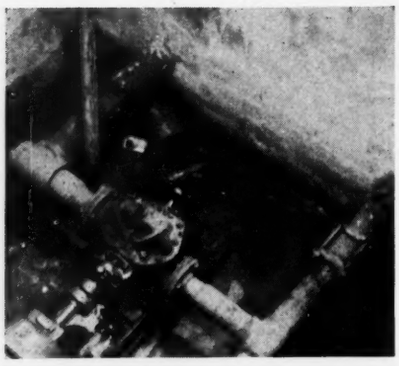
And the 29-year record of these separators in service speaks of more than unfailing performance. It points directly at the basic design and says how *right* that must be. Right basic design provides not only sufficient magnetic strength to withdraw all tramp iron, but the ruggedness that withstands the most trying conditions year after year. In addition Cutler-Hammer Separator Pulleys require only a small current; they are inexpensive as well to keep up. Ask for the counsel of the nearest Cutler-Hammer specialist. He can give you a profitable solution to this ever present problem. CUTLER-HAMMER, Inc. *Pioneer Manufacturers of Electric Control Apparatus,* 1364 St. Paul Avenue, Milwaukee, Wisconsin.



CUTLER-HAMMER
MAGNETIC SEPARATOR
C-H

ANOTHER CUTLER-HAMMER CONTRIBUTION TO THE PROGRESS OF INDUSTRY

Practical Aids to Operation



Piping Changes Correct Pump Trouble

A CENTRIFUGAL pump used for clearing yard sumps lost its suction frequently. The installation was typical of many, with a 4-in. suction pipe reduced to 3-in. flange diameter by means of a reducing nipple, as in the photo. After being primed the pump would operate from 1 to 10 min and then fail, with disastrous results to the packing and pump shaft unless promptly shut down.

It was finally determined that air or gas was collecting in the suction line, some remaining there after apparently full liquid flow was established to the pump. Then, sufficient air would carry over into the pump to air-lock it, and suction lift would do the rest.

Intake and discharge lines were cast solidly in the pump-house concrete walls, preventing any change in pipe position without excessive cost. To avoid this, the pump and motor base were elevated 9 in. off their original foundation, so that reducing nipples could be turned to a vertical position instead of horizontal. In this position there was no place in the suction line that permitted air and gas to separate from the water and subsequently air binding the pump. This change corrected the trouble.

Longview, Tex. M T PATE

Threading Plugs Into Eroded Holes

THE EROSIVE action of steam discharged into kettles and cookers is often overlooked. Because of scale and rust in suspension, steam impinging at high velocity upon metal surfaces may rapidly cut away such metals as aluminum and cast iron. While working as a machinst some years ago, before welding was the art it is today, I witnessed an attempt to weld a hole eroded in the interior wall of an 80-gal. kettle, opposite the steam entrance. The attempt failed and a machinist then took over the job.

With a hammer and chisel he broke through the inner shell and with the chisel and a half-round file made the hole circular. After threading the hole with a 4-in. pipe tap, he turned a cast iron plug, leaving an undercut knob which he squared to fit a makeshift wrench. Lubricating the plug with red lead, he screwed it tightly in place and tested the kettle under pressure. The machinist then knocked off the knob and smoothed the job with a portable grinder. Under 60-lb pressure, this kettle has since seen 3 years of service. A 60-gal. aluminum kettle was repaired in the same manner, the plug being cast from scrap aluminum. Had steam been discharged parallel with the kettle walls, necessity of repairing would not have arisen.

Cutler, Ill. W W HOLMAN

White Switch Handles

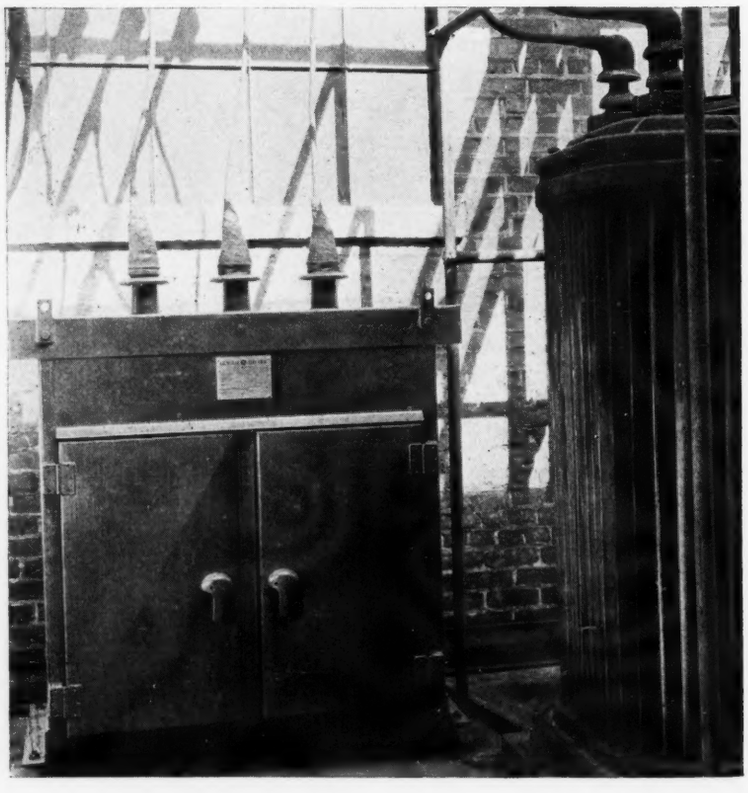
ON OUR switchboards there are a number of switches of the same size and design. Among these are two which are closed and opened frequently. From force of habit, workmen will reach for a switch without being sure it's the right one. To prevent this, we have painted the handles of the much-used switches white to make them stand out from the others on the switchboard front.

Baltimore, Md. FRANK TRAIL

Capacitors Cut Costs $1200 Per Month

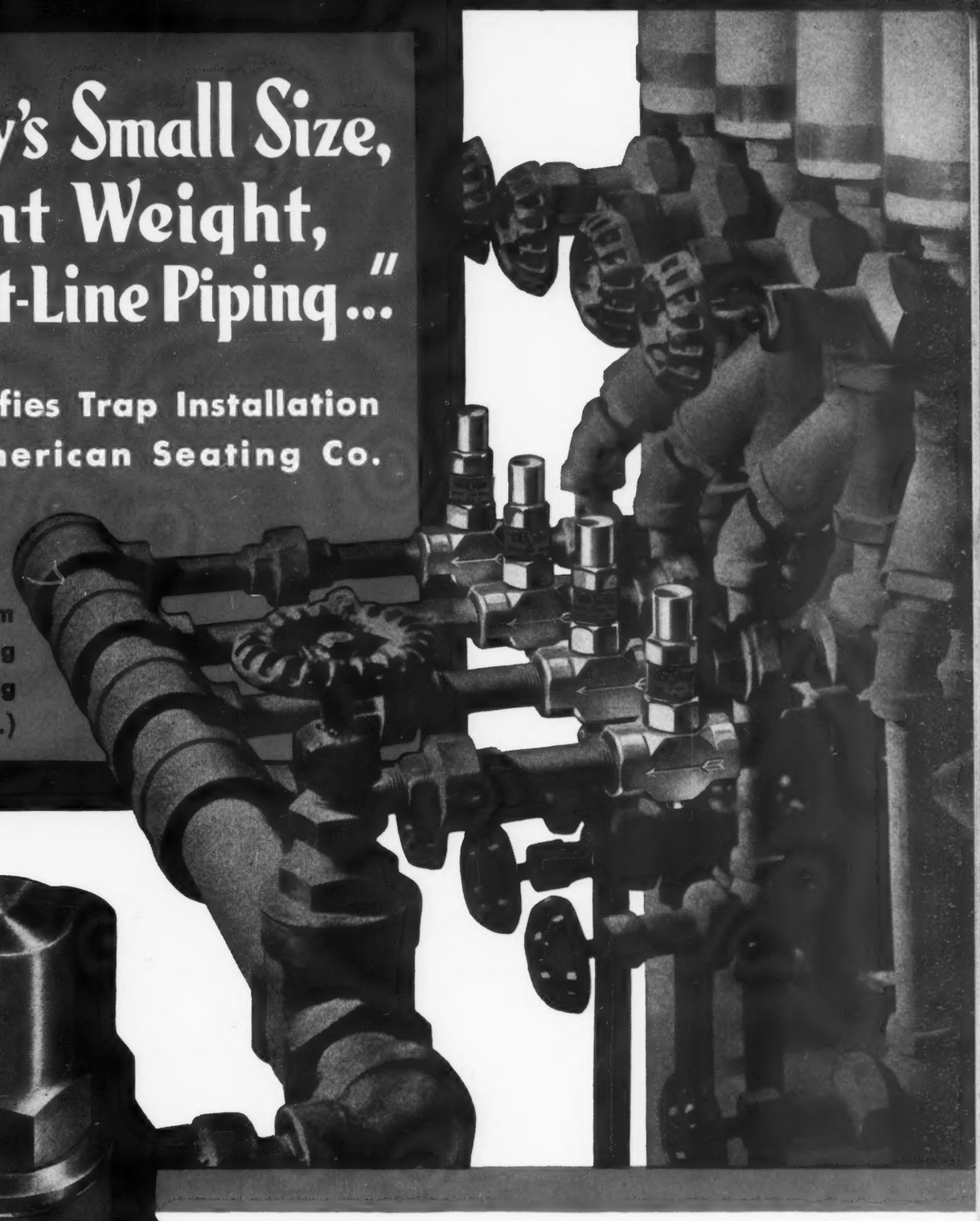
GREATER production had necessitated increased electrical capacity to improve low-voltage conditions in the automobile body plant of the Murray Corp of America. Larger transformers and costly additional feeders could have been installed, but the company's engineers decided that the same results could be obtained by installing capacitors to correct power factor and in addition reduce power costs substantially.

Capacitors were located at 22 strategic points on the 440-volt power-feeder system. Inasmuch as no floor space was available, 12 40-kva units were mounted in existing service trenches beneath the main floor, and ten larger assemblies were suspended by ceiling hangers above the production area. Two other units, rated 120-kva, 4600 volts, one of which is shown in the photo, were mounted outdoors near transformer banks supplying part

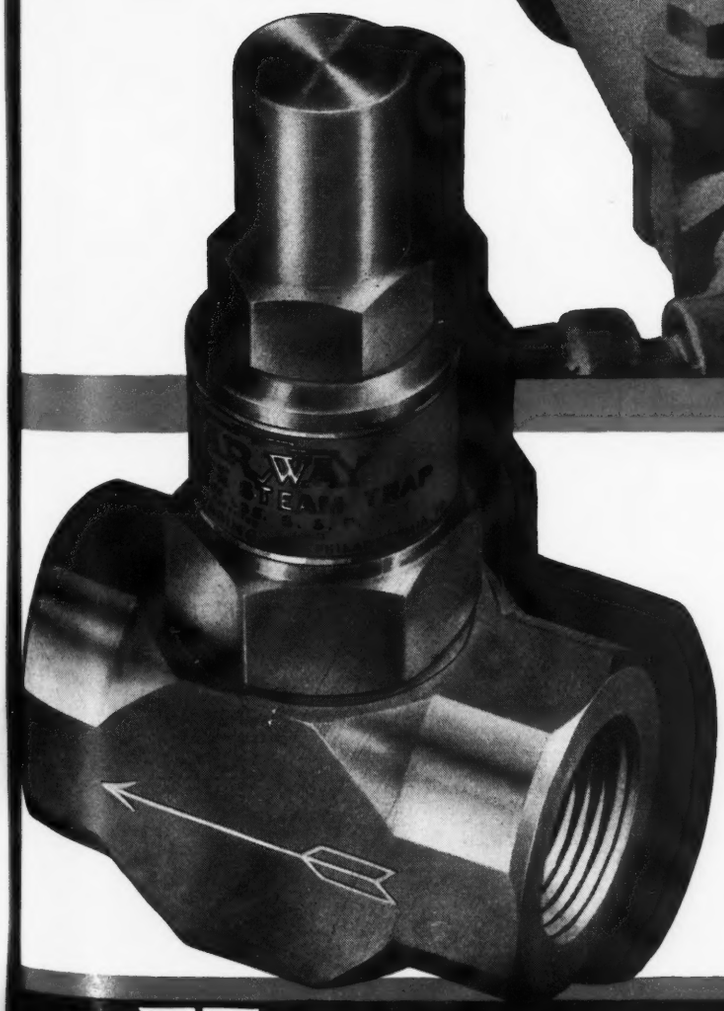


"Yarway's Small Size, Light Weight, Straight-Line Piping..."

Simplifies Trap Installation at American Seating Co.



Yarway Impulse Steam Traps Draining Heating Coils of Enamel Drying Oven (137 lbs. w.s.p.)



"Traps take care of condensate of unit heaters supplying heat to conveyor type oven for drying enamel. Steam pressure is 137 lbs. Traps discharge to flash tank, vapor going to heating system during heating season, and condensate going back to feed water heater. A strainer is used ahead of each trap and each strainer is provided with blow-down."

Congratulations to American Seating Company on the good engineering, evidenced by this efficient trap arrangement — and on their good judgment in selecting Yarway Impulse Steam Traps for their quicker heating, greater sustained heating efficiency, low maintenance cost, fuel economy, and in their saving of valuable space around machines.

Since Yarway Traps cost no more to buy, as a rule, than it costs to repair ordinary traps — why don't you replace with Yarways?

Ask your Mill Supply Dealer or write for Bulletin T-1733.

YARNALL-WARING COMPANY, 100 Mermaid Avenue, Phila.

YARWAY IMPULSE STEAM TRAP

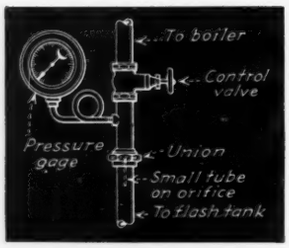
of the load in the plant at 220 volts.

Assembled with disconnecting switches, each of the capacitor units was put into service merely by making three connections. Overhead location of the units was permissible because the Pyranol-filled capacitors are fireproof. The units have been in service several months and have saved $1200 per month in power costs.

Schenectady, N. Y. M C Ross
General Electric Co

Reading Rate of Blowdown

By placing an orifice and pressure gage on the low-pressure side of the valve in a continuous blowdown line, as in the diagram, we can get a fairly good idea of blowdown rate from the gage readings. Increasing rate of flow by opening the valve increases the gage reading and vice versa. Because of reduced pressure drop across the valve, when the orifice is in place, the valve plug and seat will not be cut as



quickly as when the blowdown is piped directly to the flash tank.

The orifice is a disk brazed into one half of the pipe union. I have found that a short piece of tubing brazed around the outside of the orifice, in the center of the disk, will make the orifice last much longer than with just a plain disk. Size of orifice will have to be determined for each installation by experimenting.

Harvey, N. D. Orville Hoksch

Grease Sprayed With Cement Gun

Corrosion of box headers of water-tube boilers is serious, especially when headers have hand-hole plates. Most plants grease the headers with various preparations every time the boiler is down. Painting these by hand is a slow tedious job so we decided to use an old cement gun to spray grease by compressed air onto the header covering the plates, crabs, bolts and nuts. If the grease is too heavy we heat it or dilute it with fuel oil. We are able to complete one header with this method in 15 to 20 min. and we get a much better job, as the grease can be sprayed into places inaccessible with a brush.

We used a drip pan under each header, but found that the water would follow around the bottom and soak the firebrick. Then when the boiler was down, the brick kept the steel wet. To overcome this, a piece of strap iron was welded along the bottom of the header. This forces the drops of water to fall into the pan which is piped to waste.

The wall under the header should be no wider than necessary to have a good seal. This is especially true of the rear header. Here we had a ledge over 1 ft wide. This banked soot up the header and over the tube ends, which when damp attacked the metal. To eliminate this difficulty we corbelled the wall, leaving no place for soot to accumulate.

Mitchel, S. D. K M White

Strange Behavior of Gage-Glass Level

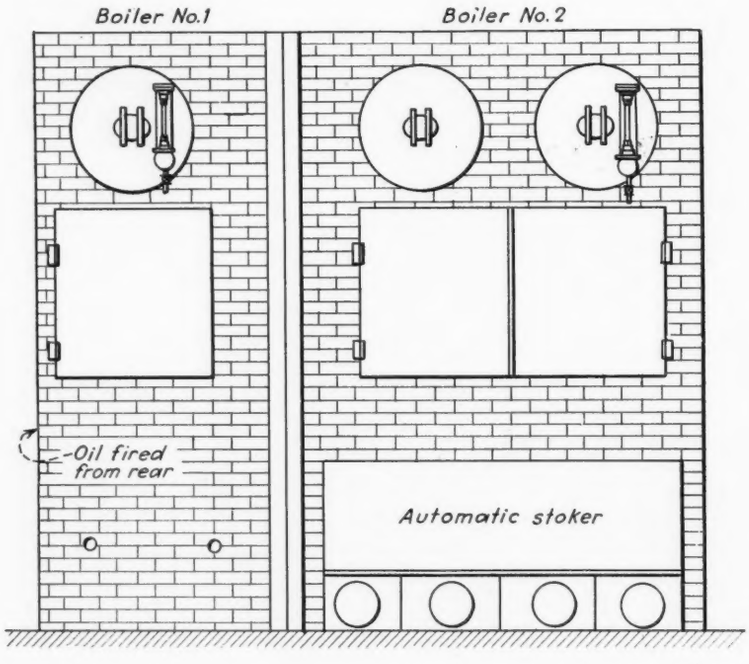
Rather strange behavior of the water in a gage glass recently brought the effects of a changed operating condition to light. Two straight-tube water-tube boilers were operated in battery and fired by automatic stokers for many years. Boiler No. 1 was a single-drum unit with 1500 sq ft of heating surface, while No. 2 boiler was 2-drum with 2500 sq ft of heating surface. No unusual conditions were noticed during this period.

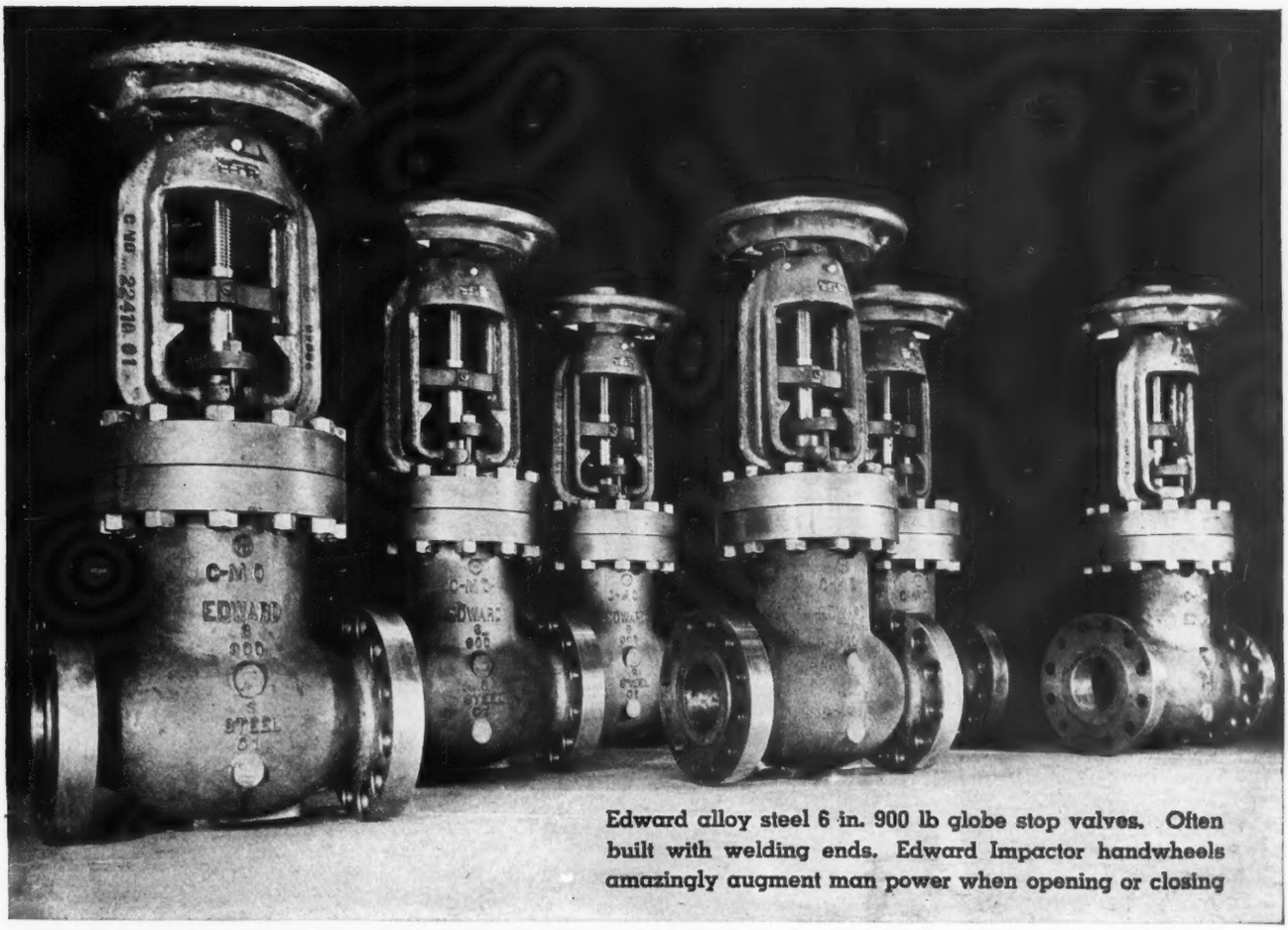
Recently, boiler No. 1 was converted to oil burning. The burners were installed at the rear in order to obtain the greater furnace volume necessary to operate the boiler at high ratings. Each time boiler No. 2 was taken off of the line, leaving boiler No. 1 in service, water level in No. 2 glass would rise slowly about 4 in. immediately after the main stop valve was closed. This action repeated itself each time the boiler was cut off the line even when all feed valves and other inlet and outlet lines were closed and checked for leakage.

As this condition started shortly after the oil burners were installed in boiler No. 1, it was apparent that there was some connection. Investigation disclosed a rather interesting fact. Referring to the figure, it will be noted that the gage glass of boiler No. 2 is on the right-hand drum, and that boiler No. 1 has a single drum. Thus, the furnace of boiler No. 2 is comparatively wide and a temperature differential across the furnace width is possible. This would be so especially if the stoker were operated at low ratings.

As the division wall was of rather light construction, a considerable amount of heat was conducted through it from the oil-fired furnace when the latter operated at high ratings. Hence, the left-hand wall of boiler No. 2 would reflect heat back into the furnace while the right-hand wall was open to radiate heat to the boiler room. The result was that the generating tubes on the left side of the boiler were exposed to somewhat higher gas temperatures, and circulation and generation of steam were faster on that side. A higher water level resulted in the left-hand drum, but when combustion rate was cut down and the stop valve closed, water level in the two drums would equalize, causing water to rise in the right-hand drum.

Cleveland, Ohio A G Wiggins

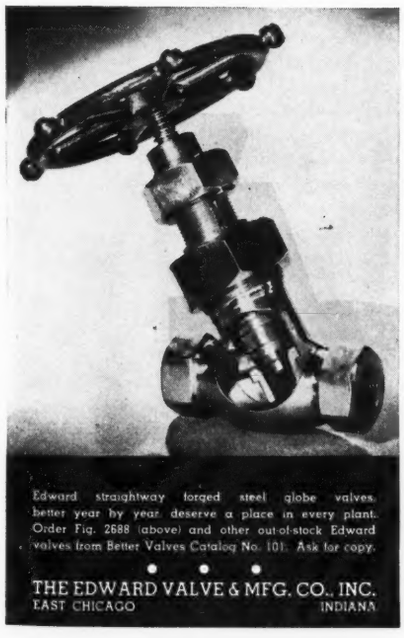




Edward alloy steel 6 in. 900 lb globe stop valves. Often built with welding ends. Edward Impactor handwheels amazingly augment man power when opening or closing

GUARDED...

by Edward Stop Valves



Edward straightway forged steel globe valves, better year by year, deserve a place in every plant. Order Fig. 2688 (above) and other out-of-stock Edward valves from Better Valves Catalog No. 101. Ask for copy.

• • •

THE EDWARD VALVE & MFG. CO., INC.
EAST CHICAGO INDIANA

IF you want to stop flow in a pipe, no valve equals a globe — or angle – stop valve in efficacy. It can cope with high temperatures and high pressures. It is first choice for throttling. And if leaks should develop – due to stray foreign matter, abuse, erosion, corrosion, improper service or old age – repairs may be made more cheaply and quickly than with other types of valves.

Built into Edward globe and angle stop valves are the results of three decades of intensive study of such vexing problems as are related to non-return, blow-off, and boiler feedline stop-check valves in which Edward has always specialized. Internal contours promote free flow without undue turbulence and cross currents. Carefully selected, painstakingly tested, and accurately machined materials prolong life. Keen inspection is maintained to catch mistakes. Design details are frequently revised to keep pace with new developments. Disks are positively guided by integral body ribs, self scouring, non-clogging, and assuring accurate seating.

For ease of operation, the Edward Impactor handwheels shown on the 6 in. 900 lb valves (above), or the super size knobbed handwheels on the forged steel valve (left) make friends with operators, save time and money, and improve plant appearance.

EDWARD VALVES

Readers' Problems

Questions for Our Readers

How Many Maintenance Men?

Question 1

AS HEAD *of the electrical-maintenance department of a large industrial plant, I would like to secure information as to how personnel requirements of such a department are estimated. I understand that there are various "yardsticks" for making such estimates, but am not familiar with them. I feel that I have an efficient organization, but am frequently confronted with the statement that the personnel of the electrical department should be some certain number for a given rate of production. These estimates are invariably too low, but without authoritative data I am at a loss to refute them*—LNR

Heating-System Water

Question 2

I WOULD *like to know what* POWER *readers think of emptying and refilling a hot-water heating system each year. Some engineers I have talked to say not to empty the system, and recommend using the same water year after year. Others are of the opinion that water should be changed yearly*—JAD

Suitable answers from readers will be paid for if space is available for publication.

Red-Leading Tube Sheets

Answers to September Question 1

Question

WHAT *would be the effect, detrimental or otherwise, of red-leading interior front and rear tube sheets after they have been cleaned of any adhering scale? A friend of mine, in charge of heating plant in a moderate-size building, states that he did this red-leading recently at the close of the heating season, and also applied red lead to the tubes that could be painted. The boilers in his plant are return tubular, about 400 sq ft, and he usually operates the system at about 4-6 in. of vacuum. His idea is that the red lead coating will slow up scaling and pitting, especially in the tubes.*

It looks to me as though the red lead would wash off within a week or two after firing up. If the idea is practical, why isn't it tried in other small plants similar to his? I would like to hear the experience of POWER *readers on this interior red-leading of tube sheets and upper tubes*—AET

Try Graphite and Oil

WHERE a heating system is layed up during the summer, the treatment it receives is important for long life. When operation is stopped the boiler should be cleaned immediately and prepared for inspection. This leaves the drums or sheets and tubes free from scale. As soon as insurance and city inspections have been completed, the drums may be protected with lead and oil or graphite and oil. They should then be closed up and completely filled with water. It has been found that deterioration is less when the boiler is full than when it is left empty.

The choice of material may be open to debate. As the oil must be removed before putting the boiler in service, which may be done with soda ash or an equivalent solvent, a material should be chosen to be carried by the oil which produces no harmful effects, either on the iron or the equipment. Red lead has sometimes given a color or deposit on gage glasses. Graphite does not seem to have this objection. In fact, the use of graphite and oil is standard practice.

Lakewood, Ohio J P SIMONS

Will Wash Off

ANSWERING AET's question regarding red-leading of tube sheets, I believe he would find his guess about the coating quickly washing off to be correct. The plan has been tried in the power-generating end of sugar mills—a strictly seasonal industry—the boilers being blown down, drained and dried as thoroughly as possible at the end of the cane-grinding season, and left untouched until the first of the next crop is ready to process. Boilers red-leaded at the time of shutdown did withstand corrosion from condensation of moisture in air better than untreated surfaces. But, in instances where it was necessary to shut down shortly after starting up such a unit—as during unseasonable rains—it was found that the coating was completely washed off all surfaces where there was any active flow of water, or steam generation.

This quick breakdown of the protective coating is to be expected when the nature of the protective material is considered. Lead oxide is carried in linseed oil, which is rapidly softened and disintegrated in boiling water.

If AET is trying to reduce scaling and pitting during active service, none of the protective coatings that are based on a liquid of animal or vegetable origin are apt to be of value. There are, however, protective coatings based on coal tar or petroleum byproducts that will withstand the active scouring effect encountered in a boiler and which will go a long way toward removing the trouble of which AET writes. Since efficiency of any such coating depends upon continuity, it follows that it will also cut down the steaming quality of the boiler in which it is used, inasmuch as such a coating is also a heat insulant.

The writer has used high-temperature aluminum paint for the protection of surfaces within the boilers of mobile road equipment (working pressures not exceeding 150 lb), care being exercised to see that the aluminum was ground as fine as possible, and that the proper liquid was used. This precaution is imperative, as the coating is apt to flake off if the surface on which it is applied is not thoroughly dry and clean at time of application. With the finest aluminum powder, such of the material as works loose and is carried over in the steam seems little more injurious to working parts than would be an equal amount of graphite.

Longview, Texas ELTON STERRETT

How to Apply Red Lead

WHILE red lead applied to the clean interior surfaces of any boiler will usually wash off within a few days after firing, especially if soda-ash or other alkali is used in water treatment, it is certain to prevent corrosion while it is on the metal. When the boiler is to be shut down for any extended period, red lead should be applied to all interior surfaces which can be reached with a

(*Continued on page* 122)

MANY STATES have adopted boiler codes based, in most cases, on the ASME Boiler Construction Code. By formulating experience and known facts, these codes promote safe boiler-plant operation. They will work most effectively if they are understood as well as followed. Printed below is a paragraph from the ASME Code. Read it, and consider the reasons for the rule. Then turn to page 124 and check your thinking with the discussion given there.

SAFETY-VALVE LIFTING LEVERS

P-282: "To insure the valve being free, each safety valve shall have a substantial lifting device by which the valve disk may be positively lifted from its seat when there is at least 75% of full working pressure on the boiler. The lifting device shall be such that it can not lock or hold the valve disk in a lifted position when the exterior lifting force is released."

Savings Begin When Nalco Comes In!

RIGHT IN YOUR BOILER is where the curves for cost and efficiency begin . . . A loss here means a loss straight through your power plant . . . New equipment installed to reduce costs never gets a chance when savings are ear-marked in advance . . . That's why we say "Savings begin when Nalco comes in!"

The Nalco System has an unusual record for reducing costs, improving performance and increasing safety. Let us show you the facts. No obligation. NATIONAL ALUMINATE CORPORATION, 6222 W. 66th Place, Chicago, Ill.

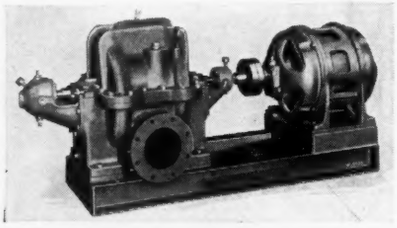
ANY WATER **NALCO SYSTEM** ANY PRESSURE

Inquiries other than domestic *except those from U. S. Possessions, Canada and Mexico,* should be addressed to ALFLOC LTD., Bush House, Aldwych, London, W. C. 2, Eng. Canadian inquiries should be sent to ALUMINATE CHEMICALS LTD., 372 Bay St., Toronto, Ont.

What's New in Plant Equipment

Condensate Pump

TWO-STAGE centrifugal hotwell and condensate pump has oversize suction openings, pickup type impellers, large vents. Cast-iron casing is horizontally split for ready access and removal of rotor. Suction and discharge nozzles are in the lower half of the casing, while an interstage passage is cast integral with the upper half of casing. Single-suction en-

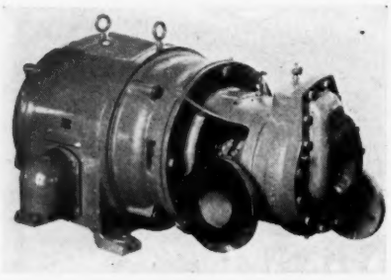


closed bronze impellers are mounted on shaft with suction openings facing inward. The back, or discharge, sides of impellers are thus adjacent to stuffing boxes, so that latter are under first and second-stage discharge pressures respectively, preventing leakage of air into the pump. Bulletin W-318-B15.

Worthington Pump & Machinery Corp, Harrison, N. J.

Motor-Pump Unit

TWO-STAGE Type MKE motor pump in one compact unit. Rotor of motor and pump impellers are assembled on a common shaft carried on two ball bearings within motor. Pump case is 2-stage volute type made of Meehanite cast iron.

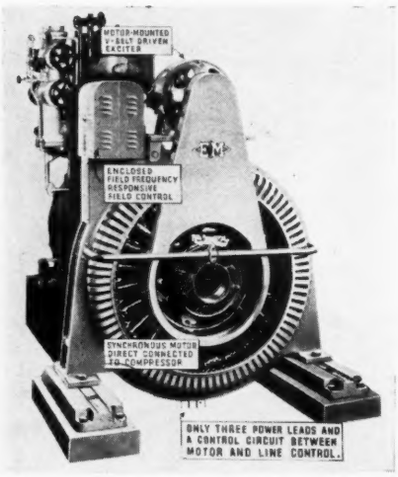


First and second stage impellers are corrosion- and acid-resistant phosphor bronze. Made for capacities of 150 to 300 gpm and for heads of 250 to 500 ft; larger capacities and heads can be furnished on special order.

Victor Equipt Co, Kimball-Krogh Pump Div, Los Angeles, Calif.

Synchronous Motor Drive for Small Compressors

PACKAGED synchronous-motor drive for reciprocating compressors such as used for air-conditioning refrigeration, said to simplify wiring and installation, and


MOTOR-MOUNTED V-BELT DRIVEN EXCITER
ENCLOSED FIELD FREQUENCY RESPONSIVE FIELD CONTROL
SYNCHRONOUS MOTOR DIRECT CONNECTED TO COMPRESSOR
ONLY THREE POWER LEADS AND A CONTROL CIRCUIT BETWEEN MOTOR AND LINE CONTROL

reduce amount of floor space required. Field-control equipment for synchronous motor, as well as exciter, is mounted on top of motor. Synchronous motor can thus be shipped with all wiring complete between motor, exciter and field control. Only wiring required on the job is between synchronous motor and line-control switch.

Electric Machinery Mfg Co, Minneapolis, Minn.

Fluorescent Lamp *(below)*

LINE of fluorescent "Lumiline" lamps gives 3 to 10 times the light for equivalent power input to standard Mazda lamps. These new lamps comprise an evacuated glass tube 18, 24 or 36 in. long, with a cathode in each end, between which an arc is maintained. Mercury vapor sustains the arc. To put the lamp in service, switch *A* is closed to complete a circuit through the cathodes to heat them. When cathodes have been brought to the proper temperature, switch *A* is opened, producing an inductive kick between the cathodes, which strikes the arc.

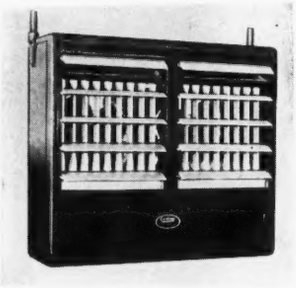
Made in 15-, 20- and 30-watt sizes. 18- and 24-in. length sizes operate on 110 or 120 volts ac; 36-in. size requires 208 to 230 volts. Lamps giving green light produce 60 to 70 lumens per watt, white and daylight lamps 30 to 35 lumens per watt, compared to approximately 10 per watt for ordinary Mazda lamps. These new lamps approach the kind of lighting advocated by the Science of Seeing at a cost within normal operating budget of commercial establishments.

Heat as an objectionable feature in high-intensity lighting is practically eliminated. In air-conditioned interiors, the lighting heat factor is a serious one. For every 1000 watts of tungsten lighting, $100 of air-conditioning equipment is required to remove the heat generated. With fluorescent lighting that produces only 25% the radiant heat of tungsten lighting, a real saving can be made in air-conditioning costs.

General Electric Co, Schenectady, N. Y.

Unit Heater

GAS-FIRED unit heater made in three sizes: 1-fan unit of 1300 cfm, 2-fan unit of 2600 cfm, and 3-fan unit of 3900

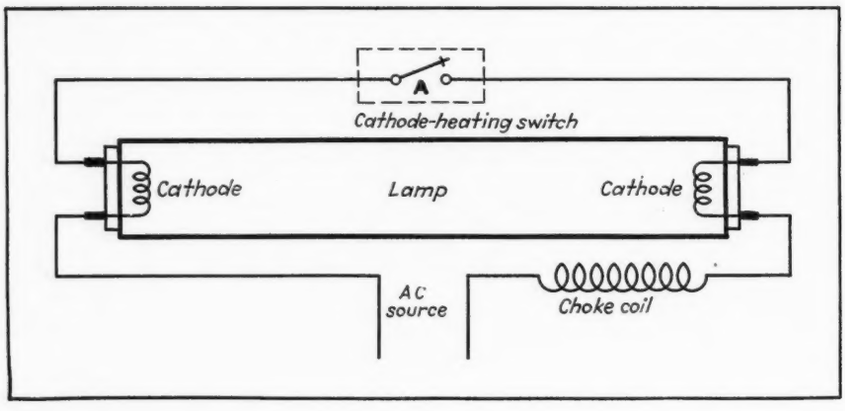


cfm. Cast-iron combustion chambers and flue collectors; chromium-steel alloy heat-exchanger tubes; aluminum-painted louvres. Ceiling suspended.

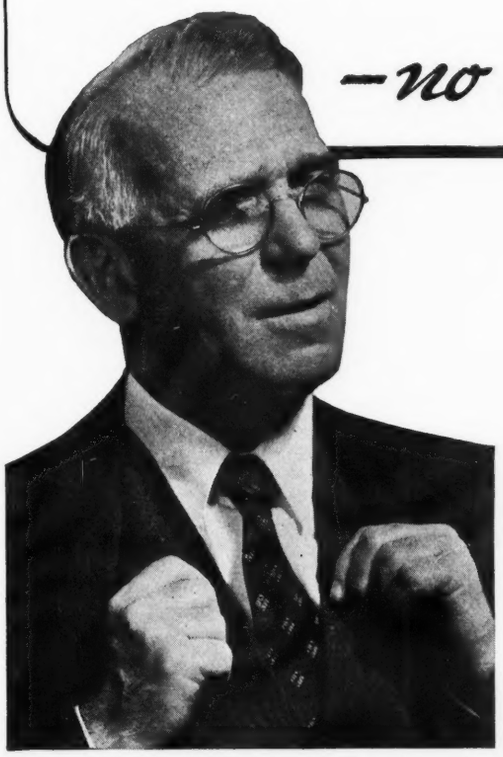
Carrier Corp, Syracuse, N. Y.

Electrostatic Voltmeter

PORTABLE electrostatic voltmeter for measurement of ac or dc voltage on systems where one line is grounded, is made in ratings of 3, 5, 10, 15, and 20 kilovolts. Features include light-beam



"FOUR YEARS' USE OF BUROMIN —no boiler shutdowns!"

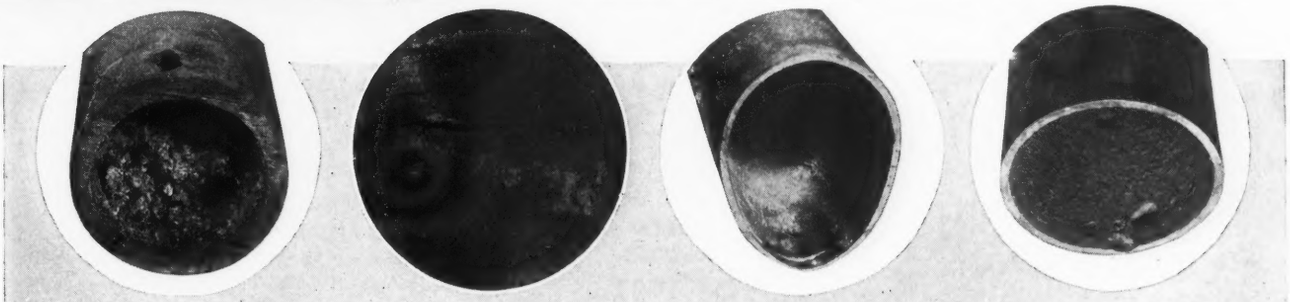


"YOUR treatment is doing everything we expected of it," reports this plant executive. "After four years' use we find there are no deposits inside of the boiler tubes." And we say, "There won't be any deposits as long as Buromin is used according to specifications."

But Buromin used as directed by Hall Laboratories does more than prevent scale. It eliminates costly shutdowns caused by corrosion, pitting, carry-over and embrittlement. Years of painstaking research were necessary to learn how these evils could be corrected. This research has resulted in definite and concrete methods for correctly and economically conditioning waters of all types.

Buromin and the Hall Laboratories take the guesswork out of boiler water conditioning. Nothing is left to chance. Your boiler water is scientifically analyzed and the control of the treatment determined. The list of boilers treated with Buromin includes those of every capacity and water of every kind.

Our engineers will gladly show you how to condition your boiler water to avoid costly failures. Write, wire or phone.



BUROMIN PREVENTS THESE EVILS

CARRY-OVER. Of course boiler water should stay in the boiler. When it doesn't, in the case of incorrectly conditioned water, and carries over with the steam, superheaters frequently plug up.

EMBRITTLEMENT. Improperly conditioned boiler water allows "caustic embrittlement" to start and tough steel often fails like brittle glass.

SCALE LIKE THIS. Even when no thicker than 1/100 of an inch, forming at the hottest part of a boiler tube, may lead to costly destruction and boiler shutdowns.

PITTING. Here's a cross-section of a boiler tube destroyed in only a few months by pitting. Correctly conditioned boiler water would have saved this tube from premature failure.

BUROMIN

THE BUROMIN COMPANY

300 ROSS STREET · PITTSBURGH, PA.

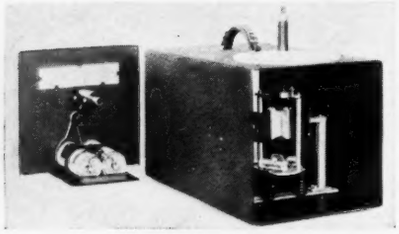
This request may save you many dollars:

THE BUROMIN COMPANY
300 Ross St., Pittsburgh, Pa.
Gentlemen:
Please send me, without obligation, your new booklet "Buromin—for clean boilers, continuous service, enduring economies, lasting satisfaction."

Name.....

Position..... Company.....

Address.....P-11-33

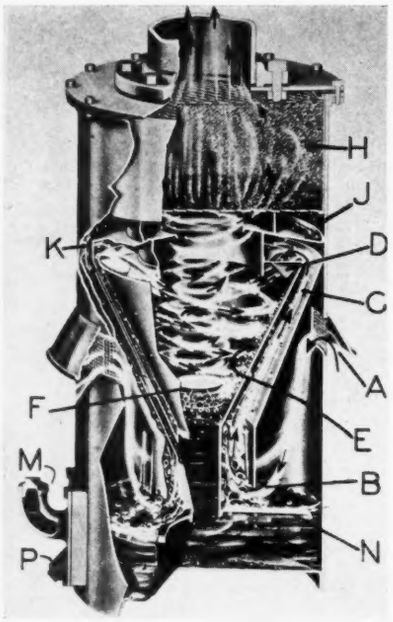


pointer, magnetic dampening, and high-voltage terminal with current-limiting resistor. Accuracy of 2% full-scale value is maintained in all ratings, when used on either ac or dc up to 700 cycles per sec. Responsiveness is approximately 4 sec.

General Electric Co, Schenectady, N. Y.

Oil-Bath Air Cleaner

"CYCOIL" oil-bath air cleaner designed for protection of engines and compressors subjected to extremely heavy dust concentrations. Effectiveness of the unit is attributed to the fact that it precleans the compressed air—frees it of most of the entrained dust and oil before it reaches filter cell. Dust-laden air enters ports *A*, which are screened and protected against rain. Sweeping downward and across plates *N*, it is mixed with oil at *B* and receives its first cleaning, as the heavier particles of dust are deposited in the oil bath at this point. Next, air is carried upwards through passages *C*, where it is further cleaned by brushing against oil-coated walls. Impinging against *D*, direction of air-oil mixture is reversed. In its passage downward into cone-shaped element *E*, it is brought into contact with vanes that give it a whirling motion, thus throwing dust and heavier oil particles against the walls, whence they flow by gravity back into the oil reservoir through pipe *K*. Thoroughly precleaned, air is caused to spiral upward into and through filter cell *H* by means of plate *F*, which also prevents dust-laden air at tip of cone



from being swept along into the filter. There last trace of oil and dust in the air is removed, dust being held while oil drains through *J* and *K* into the reservoir for recirculation, foreign matter settling to the bottom. Any floating dust, lint, etc, is caught beneath plates *N*. Normally, maintenance involves draining oil reservoir periodically, removing plate *P* to scrape out sludge, and refilling with clean oil to top of filter plug *M*. Filter cell of crimped wire does not require frequent cleaning because of air precleaning. Made in sizes 250 to 4000 cfm. Bulletin No. 130-A.

American Air Filter Co, Inc, First & Central Ave, Louisville, Ky.

Ratio Meter

DIRECT-READING ratio meter has two flow-metering elements, one for air and one for gas. The pointers cross in the chart area so that intersection of the pointers indicates relation between the two flows. As long as pointers cross on the vertical or zero line, a neutral flame is being maintained. If they cross in the area to

the right, there is shown percentage of excess air. Conversely, if pointers cross at left, there is shown air deficiency. May be used on all types of heating equipment, both manual and automatic control, to show relationship between fuel and air.

Askania Regulator Co, 1603 S Michigan Ave, Chicago, Ill.

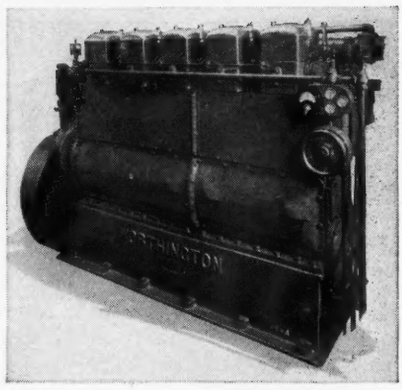
Corrosion-Resistant Alloy

"Z" NICKEL combines strength of steel and corrosion resistance of nickel. It contains 98% nickel and can be heat treated to as high a hardness as 46 Rockwell C and tensile strength 250,000 lb per sq in. Furnished as hot-rolled rod, cold-rolled rod, wire and strip. Can be prequenched for hardening if desired.

International Nickel Co, 67 Wall St, New York, N. Y.

Vertical Diesel

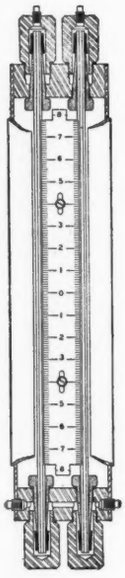
TYPE BB vertical direct-injection diesel developed for continuous heavy-duty loads and as peak-load units for larger plants having other prime movers. Construction makes this engine suitable for



rock-product plants, oil-field work, grain mills, etc, where quantities of dust or abrasives may fill the air. Bulletin S-500-B35.

Worthington Pump and Machinery Corp, Harrison, N. J.

High-Pressure Manometer



WILCOX straight-tube, high-pressure manometer for pressures up to 1000 lb permits use of straight tubes that are sealed against leakage by synthetic rubber sleeves, thus eliminating strain or stresses in the glass. Because there is no U-bend and only lightest contact between glass and metal parts, there is said to be no distortion of tubes when seal is made. If glass is accidentally broken, only one side need be replaced.

Daniel Orifice Fitting Co, 3352 Union Pacific Ave, Los Angeles, Calif.

Metal-Spray Gun

TYPE E "Metco Metallizing Gun" was developed to meet demand for faster, more reliable unit. Extremely fine coatings are obtained at production speeds, and this combined with simplified adjustments, permit continuous operation with

PARTIAL LIST OF ORDERS RECEIVED

FOR THE NEW COPES FLOWMATIC REGULATOR

USER AND LOCATION	DATE	BOILER DATA NO.	MAKE	WSP LB.	MAX. EVAP. LB./HR.
Canadian steel mill	1937	1	Freyn	130	25,000
Canadian steel mill	1938	1	B & W	450	120,000
Connecticut industrial plant	1937	2	Riley	700	
Illinois industrial plant	1937	2			
Kansas utility plant					
Maryland textil					200,000
Michigan chemica		1	F-W	1325	300
Michigan paper m	1937	1	Baden.	550	
Michigan rubber company	1937	3	Lasker	450	
Michigan utility plant	1937	1	B & W	850	400,000
Michigan utility plant	1938	1	F-W	875	400,000
Missouri utility plant	1938	1	B & W	225	120,000
	and 1938	2	W & W	180	110,000
Nebraska utility plant	1937	3	B & W	400	140,000

ANOTHER ORDER -- Connecticut utility selects COPES Flowmatic for new Babcock & Wilcox Integral Furnace Boiler, 675 pounds pressure, 150,000 pounds per hour. Gibbs & Hill, Engineers.

ANOTHER ORDER -- Combustion Engineering Company orders COPES Flowmatics for two 440-pound Type VA-A Boilers for new North Carolina paper mill. J. E. Sirrine & Company are engineers.

USER AND LOCATION	DATE	BOILER DATA NO.	MAKE	WSP LB.	MAX. EVAP. LB./HR.
Nebraska utility plant	1938	2	C-E	475	200,000
New [illegible]y industrial plant	1938	1*	C-E	400	50,000
[illegible]brewery	1938	3	C-E	410	75,000
[illegible]ndustrial plant	1938			[illegible]n. 650	100,000
Ohio steel mill				415	330,000
Ohio [illegible]				150	85,000
[illegible]	1938	1	Vogt	450	100,000
[illegible] mill	1937	1	Spgfld.	600	100,000
[illegible]nsylvania steel mill	1938	1*	B & W	400	85,000
Pennsylvania utility plant	1937	1	B & W	675	200,000
Pennsylvania utility plant	1938	1	F-W	875	400,000
Texas chemical plant	1937	1	B & W	400	200,000
Texas oil refinery	1937	1*	Riley	600	350,000
Virginia paper mill	1938	2	B & W	450	120,000

*Two COPES Flowmatic Regulators purchased for each boiler.

Name of any user listed above will be furnished on request.

Why this trend to the new Flowmatic?

There are good reasons why the trend in modern plants is definitely to the new COPES Flowmatic for effective feed water regulation. Closer boiler water level control on the most rapidly swinging loads. Trouble free operation with only routine attention. Simple adjustment. Easy installation. All add up to safer, more economical operation of fast steaming generators. To be sure of these benefits, specify the COPES Flowmatic. Write, on your letterhead, for descriptive Bulletin 409-A.

NORTHERN EQUIPMENT CO., 1111 GROVE DRIVE, ERIE, PA.

Feed Water Regulators, Pump Governors, Differential Valves
Liquid Level Controls, Reducing Valves and Desuperheaters

BRANCH PLANTS IN CANADA, ENGLAND, FRANCE, GERMANY, AUSTRIA AND ITALY . . . . REPRESENTATIVES EVERYWHERE

Get closer boiler water level control with the new

COPES

FEEDS BOILER ACCORDING TO STEAM FLOW•AUTOMATICALLY

FLOWMATIC

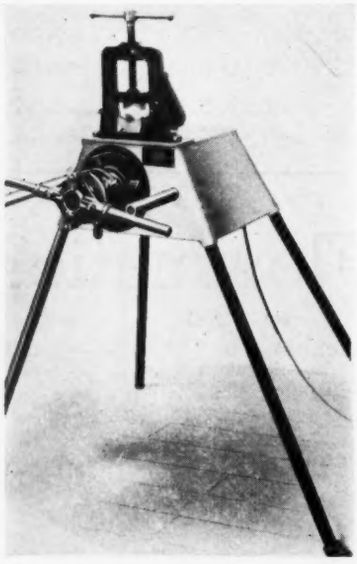
★ REGULATOR

maintained speed and quality. Improved nozzle and jet construction reduce gas consumption and result in deposit of maximum amount of metal sprayed. A multiple-jet turbine makes available two speed ranges, which cover all speeds necessary for commercial metals. Operates from either acetylene tanks or generators at max recommended pressure of 15 lb; only 60-lb air pressure required.

Metallizing Engineering Co, Inc, 44 Whitehall St, New York, N. Y.

Pipe Vise Stand

MOTORIZED pipe vise stand enables user to thread, cut and ream pipe up to 2-in., by power. Pipe is gripped in a universal, bar-operated, scroll-type chuck and is revolved by power unit concealed in upper part of stand. Die stock, cutter

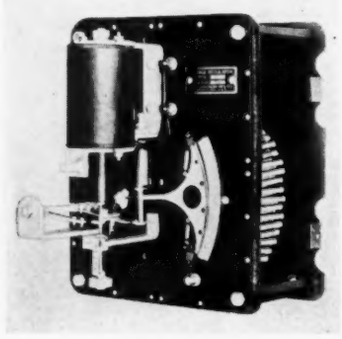


or reamer is placed on pipe in conventional manner with handles resting on sliding arms that are built into sides of the stand. When power is turned on, sliding arms take torque of the pipe tools. Net weight is 11 lb.

Oster Mfg Co, 2057 E 61st Place, Cleveland, Ohio.

Voltage Regulator

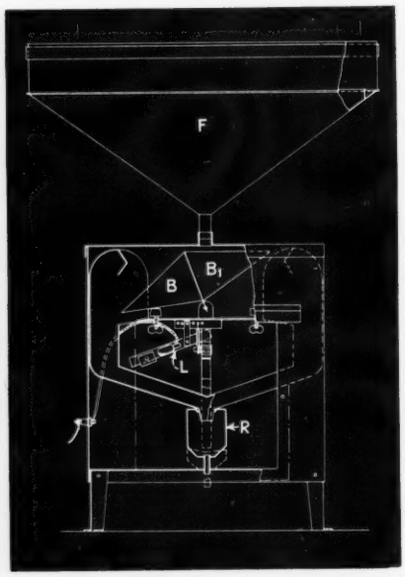
TYPE V-O rocking-contact voltage regulator, designed for automatic voltage control of small ac and dc generators, is quick acting, regulating voltage by directly varying resistance in the field circuit. Consists of a sensitive solenoid-actuated plunger that acts upon a main shaft, rocking a special carbon-rimmed contact sector over the inner surface of a commutator, the segments of which are connected permanently to the regulating resistance. Segments are heavily silver plated to insure positive contact surface, and are insulated one from another and held in place on a base to prevent misalignment. Descriptive Leaflet No. 2326.



Allis-Chalmers Mfg Co, Milwaukee, Wis.

Rain Gage

HILDABRAND remote recording rain-gage system can measure rainfall at several remote stations and transmit these measurements to a central station where they are recorded automatically. The gage comprises funnel *F* for collecting rainfall, which runs into either one of two measuring buckets, *B* and B_1. Flow from the dumping bucket goes into receptacle *R*. This receptacle is attached to one end of lever *L* on which is mounted a mercury switch. When water is dumped into *R*, it overbalances lever *L* and closes mercury switch to give a record. An opening in the bot-

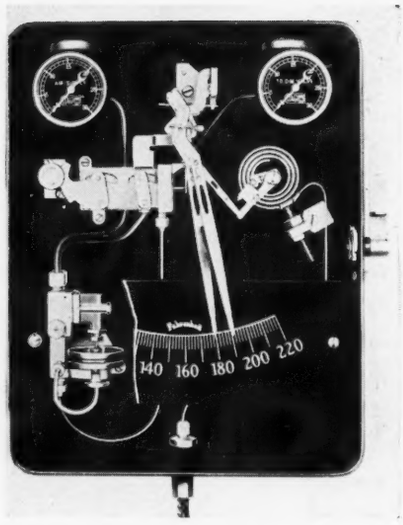


tom of the receptacle allows the water to drain out slowly, after which the lever and receptacle return to normal position, ready for the other bucket to dump.

Technical Products Co, Inc, 6670 Lexington Ave, Los Angeles, Calif.

Indicating Controller

DIRECT-SET "TAG" indicating controllers made in two types: "On-Off" or "Throttling", Model No. 9-TIC for temperature and No. 9-PIC for pressure. On-Off instrument will open diaphragm valve if temperature is slightly below setting point, and will close valve if temperature rises slightly above. Throttling controller is identical except for adjustable flapper that provides sensitivity adjustment from hairline to 100% throt-

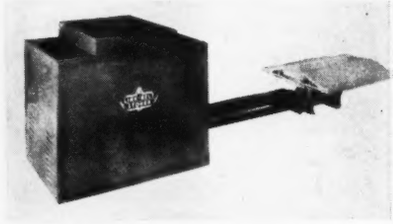


tling range. Both have direct-set feature, in which white control pointer and red setting pointer indicate on 5½-in. graduated scale. Bulletin No. 1175.

C J Tagliabue Mfg Co, Park & Nostrand Aves, Brooklyn, N. Y.

Stoker

No. 15 STOKER is designed to burn a variety of bituminous stoker coals, and will handle 3500 sq ft of radiation. Hopper is enclosed; front compartment houses fan, motor, transmission and automatic air control. Transmission shear pin has a "Load Signal", which announces when the pin shears, should an obstruction get into feed tube. Burn-



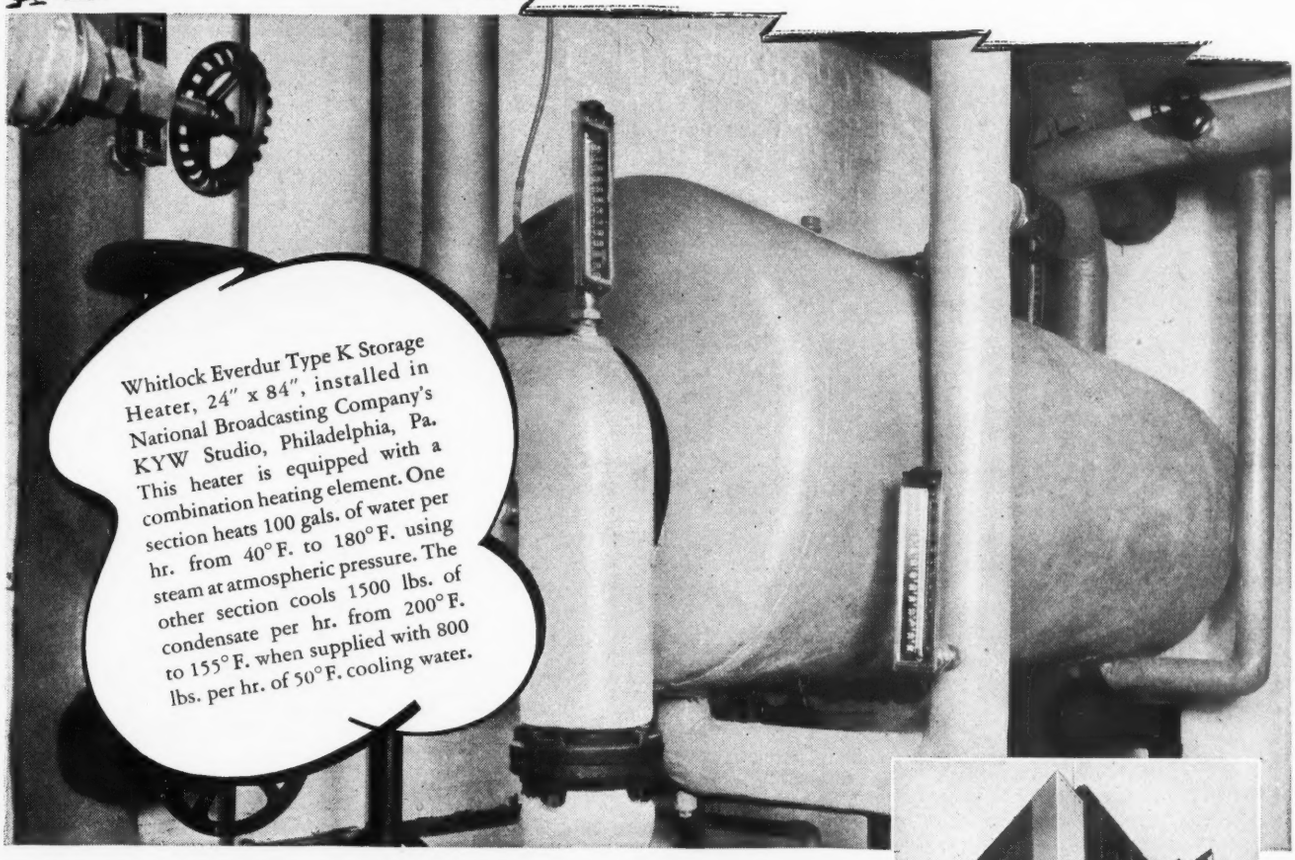
ing head has laminated tuyeres with primary and secondary air ports. Will burn both low-fusion, non-caking bituminous coals and high fusion, caking and coking coals. Flexibility to meet local boiler conditions secured by varying length of tuyeres.

Link-Belt Co, 307 N Michigan Ave, Chicago, Ill.

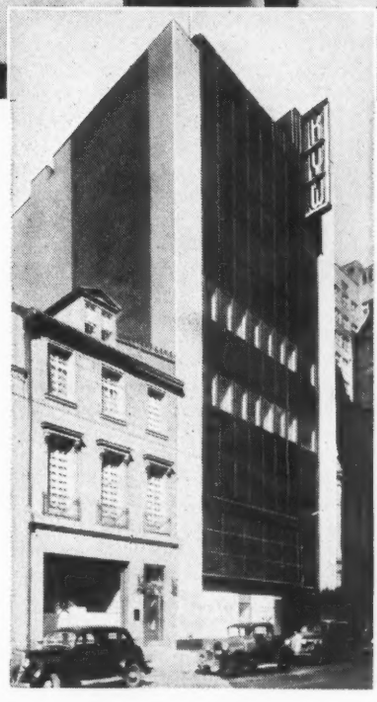
Defrosting Method

"KILFROST," a paste, applied to pipes of brine and ammonia systems, said to make removal of frost and ice easy. Where present method of defrosting is "snow banging," defrosting is carried on in ordinary way and pipes painted with Kilfrost. Then when pipes are next defrosted, growth will be soft and will tap or pull off with ease, leaving clean pipes. Where chambers are defrosted by other means, two methods can be used: (1) After defrosting pipes, start up refrig-

Station KYW—equipped with rustless Everdur—to assure longer service



Whitlock Everdur Type K Storage Heater, 24" x 84", installed in National Broadcasting Company's KYW Studio, Philadelphia, Pa. This heater is equipped with a combination heating element. One section heats 100 gals. of water per hr. from 40° F. to 180° F. using steam at atmospheric pressure. The other section cools 1500 lbs. of condensate per hr. from 200° F. to 155° F. when supplied with 800 lbs. per hr. of 50° F. cooling water.



THE TREND toward modern, more efficient water heating practice is increasing rapidly. This is one reason why heater shells of non-rust Everdur are in such great demand by building and plant owners throughout the country. They have realized that, with Everdur, they get long term economy. Everdur heater shells will be giving excellent service long after those made of rustable metals have been discarded.

RUSTLESS AND STRONG

Everdur—The American Brass Company's copper-silicon-alloy—is rustless as copper, yet exceptionally strong. It is easily welded and reasonable in price. This rare combination of qualities means rust-free hot water indefinitely, and reduced expense for upkeep. Everdur tanks and heaters are available for every purpose from leading equipment manufacturers. 8899

Everdur TANK METAL ANACONDA from mine to consumer

THE AMERICAN BRASS COMPANY, General Offices: WATERBURY, CONN.
In Canada: Anaconda American Brass Ltd., New Toronto, Ont. • Subsidiary of Anaconda Copper Mining Co.

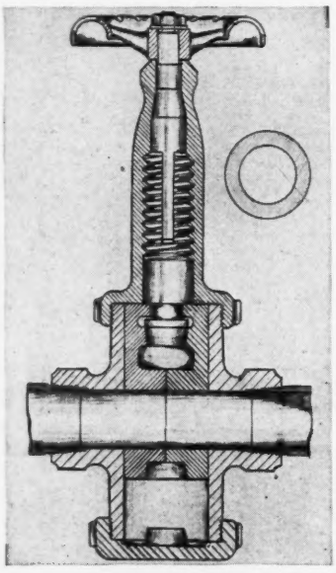
EVERDUR is a trade-mark of The American Brass Company, registered in the United States Patent Office.

eration. As soon as light bloom of frost has formed on pipes, paste is applied. (2) If after defrosting pipes, conditions are such that pipes become dry, paste is applied before starting up refrigeration.

Refrigerating Utilities Co, 370 Lexington Ave, New York, N. Y.

Gate Valve

PACKLESS, "Stream-Flow" gate valve carries a cylindrical bore at right angles to line of flow. A cylindrical gate is moved up and down by a screw in valve bonnet, and is prevented from turning



by a key in the bore. Combines salient construction features of both plug and gate valves. Made in sizes ½ to 8 in. in standard metals, also in special metals and alloys for corrosive liquids and gases.

Monat Valve & Forge Co, Bessemer Bldg, Pittsburgh, Pa.

Smoke-Density Indicator

"PHOTOSWITCH" smoke control, Type A20C indicates by bell or other signal in boiler room, when smoke passing through furnace flue exceeds a predetermined density. Photoswitch control and light source are mounted on opposite sides of flue or chimney on rigid brackets. Light beam projected by light source looks through a small opening in the flue, across inside of flue, through a second opening to control eye. Bell or signal light, at any convenient location, is wired to terminal block inside control housing. Operates on 110 volts ac.

Photoswitch, Inc, 21 Chestnut St, Cambridge, Mass.

Switchboard Wire

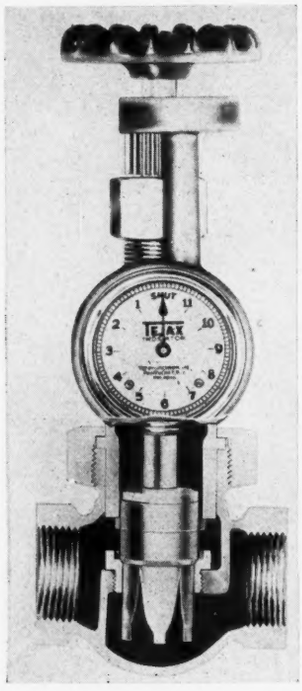
"DELTABESTON" switchboard wire is insulated with a new synthetic compound that can be easily bent at sharp angles without rupture to insulation. Said to be impervious to water and moisture, is

fireproof and flame-retarding. Insulation is applied directly to tinned copper conductor to form a seamless tube. Pure asbestos is then felted around the compound and a woven braid added that is impregnated with a flame-resisting compound.

General Electric Co, Bridgeport, Conn.

Dial Control Valve

DIAL INDICATOR valve is a hand throttling valve and dial gage for difficult regulating problems. Bold-face valve-position indicator enables precise settings and easy duplication of desired result. High



adjustment gives 300% more valve turns per unit of lift. Wire drawing is offset with renewable seatings and plug made from bronze, Monel, stainless steel or Nitralloy.

Tefft-Jackson, Inc, 2 Allens Ave, Providence, R. I.

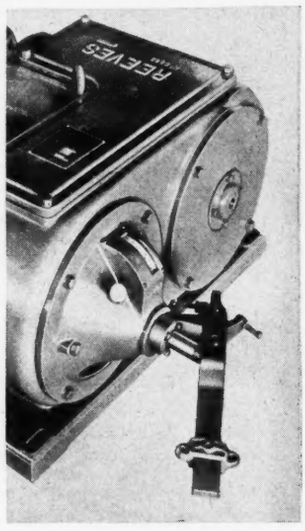
Buttweld Pipe

TYPE C-P buttweld pipe is made in continuous-process mill (see cut) under Fretz-Moon patents heretofore used in England, Germany and Australia. Manufacturer claims cleaner welds, smoother and cleaner inside finish, more durable pipe and uniform 20-ft lengths, resulting from closely controlled heat and welding operation. Sizes ½ to 3 in. ID.

Spang Chalfant, Inc, Grant Bldg, Pittsburgh, Pa.

Automatic Control for Reeves Motodrive

"MOTODRIVE," a variable-speed control unit combining speed-control mechanism, motor and gear reducer in one assembly, has been on market for some time. Mechanical automatic control, however, is new device to regulate speed of Motodrive. On the motor (constant-speed) shaft of the Motodrive is a cover plate



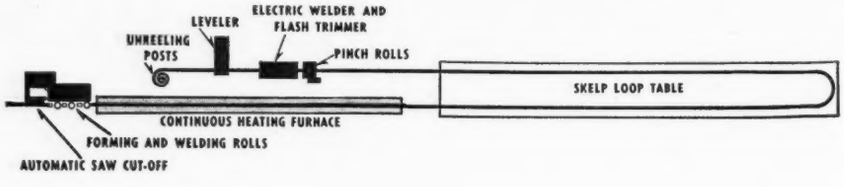
including a lever bracket and extended lever that may be attached directly by cable or chain to a compensating or floating roll (where properly balanced by weights), pressure regulator, etc, from which indication of required speeds can be taken. Movement of lever is transmitted to speed-changing mechanism to change speed of Motodrive in accordance with indicating movement.

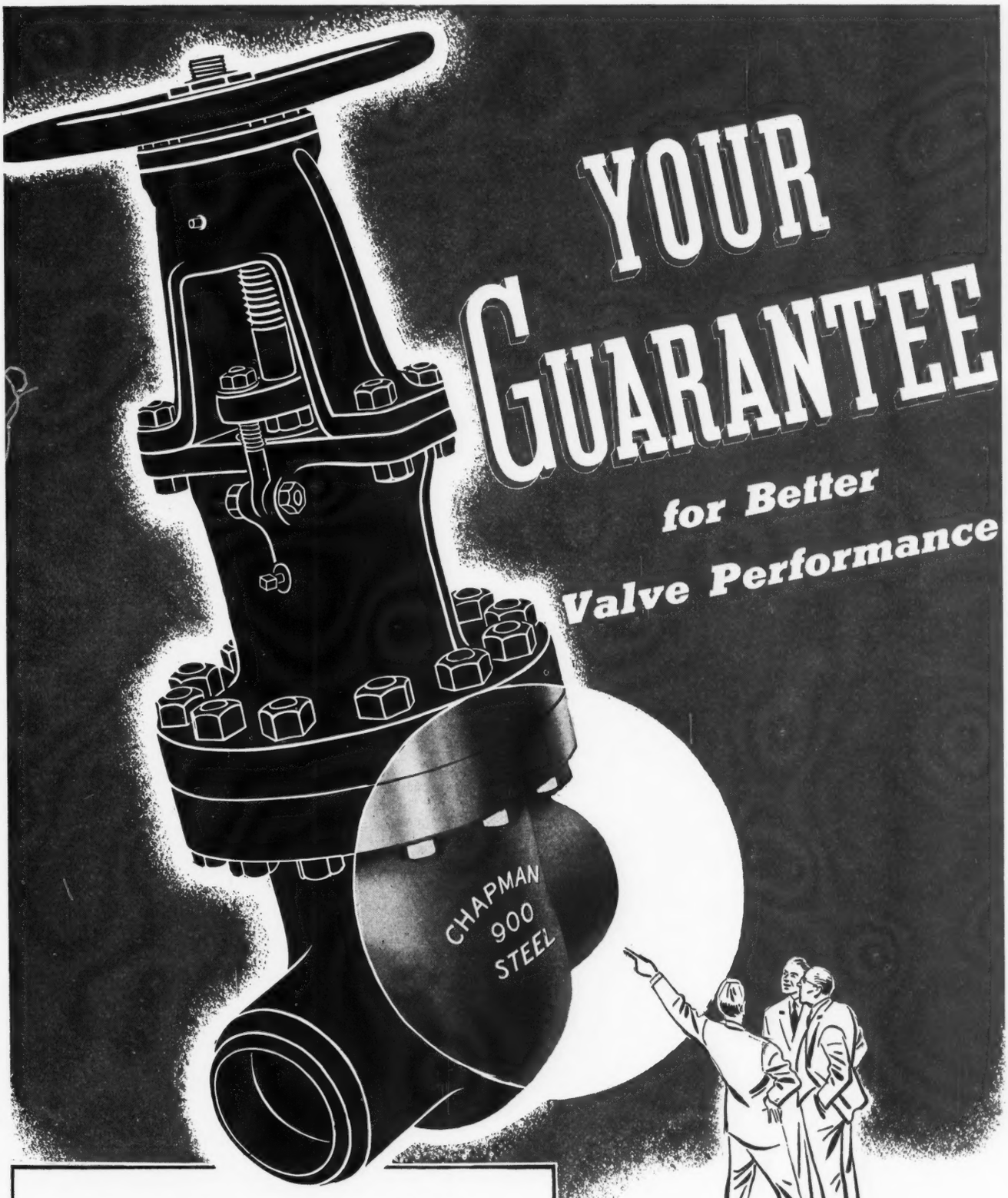
Reeves Pulley Co, Columbus, Ind.

Thermal Plug Fuse

"TRICO-MATIC" thermal time-lag fuse is former "Colortop" plug fuse to which has been added a builtin thermal overload cut-out which holds starting and momentary overloads, yet gives protection on prolonged overloads. Other features are: color indicator for all popular sizes, all-porcelain shock- and vent-proof top, a flag indicator when blown, large ampere rating under window, flat releasing spring under copper link giving maximum travel in opening arc when blown and an arc-confining disk.

Trico Fuse Mfg Co, 5th St at Chambers, Milwaukee, Wis.





YOUR GUARANTEE

for Better Valve Performance

Gate, globe, check and angle valves. Valves with all types of operating mechanisms. Valves for temperatures up to 1000° F. Valves for pressures up to 1500 lbs.

MADE IN THESE ALLOYS

Carbon Steel—Carbon Molybdenum Steel—Chrome Nickel Steel—Nickel Steel—Chrome Molybdenum Steel—Chrome Tungsten Steel—Chrome Nickel Tungsten Steel.

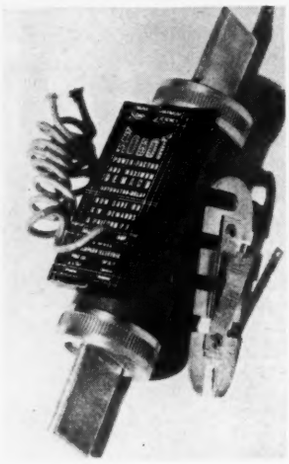
Write for Catalog

THE CHAPMAN VALVE MFG. CO. Indian Orchard, Mass.

CHAPMAN
Power Plant Valves

Fuses with Alarm

"ROBOT" fuses are now available in all knife-blade terminal sizes from 61 to 600 amp and voltage up to 600 volts, as well as in smaller ratings. These refillable fuses have a fuse element to which is attached a bi-metallic strip. As the temperature of the fuse link increases with load, one end of the strip moves away from the link to close a contact and give an alarm at a predetermined load.

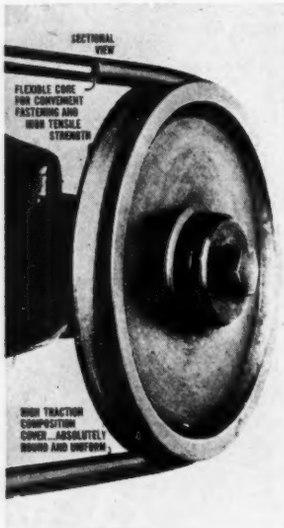


The contact can be adjusted to close at load of 75 to 125% of fuse rating. Time-delay characteristics are designed into the fuse element, so that overfusing because of motor-starting loads is not necessary. The alarm gives warning of overloads, prevents unnecessary blowing of fuse by calling attention to abnormal conditions in the circuit as they occur.

Champion Electric Fuse Co, 784 Broadway, New York, N. Y.

Composition Belting

ROUND composition belting designed for light machinery, as in shoe and garment factories, consists of a strong inner core

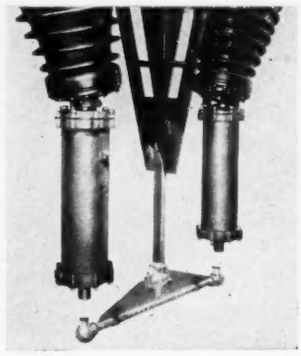

SECTIONAL VIEW
FLEXIBLE CORE FOR CONVENIENT FASTENING AND HIGH TENSILE STRENGTH
HIGH TRACTION COMPOSITION COVER...ABSOLUTELY ROUND AND UNIFORM

around which is firmly attached a thick composition surface. The core is claimed stronger than steel and able to stand an indefinite amount of flexing. To fasten ends of this belting, two inches of composition are removed and core ends tied together. Manufacturer plans to announce soon a line of flat and V belts made by same method.

Sudbury Laboratory, South Sudbury, Mass.

Multibreak Interrupter

RECENTLY subjected to interrupting tests on 138- and 230-kv systems, new GE interrupters consistently cleared short circuits as high as 2,000,000 kva in less than 5 cycles. This interrupting device

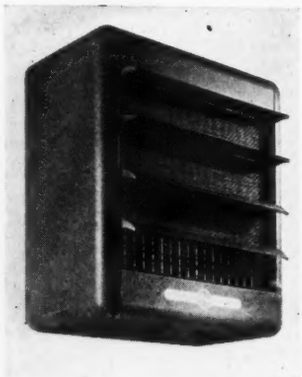


uses oil-blast principle. Pressure created by the arc forces oil across the arc and out through ports in cylindrical housing. Tests disclosed that six breaks per terminal for 230-kv, and four for 138-kv service, were adequate.

General Electric Co, Schenectady, N. Y.

Unit Heater

PROPELLER-FAN "hiJet" heater made in 18 sizes for steam or hot water to handle air capacities of 275 to 5060 cfm. Heating element has loops to absorb difference in expansion and contraction between individual tubes. Entire tube and loop is fabricated of red brass. Pat-

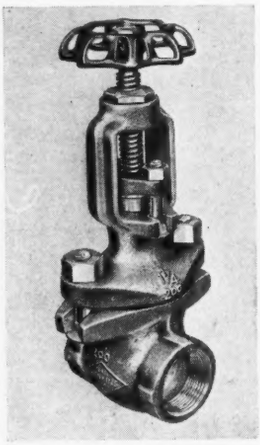


ented spray tube maintains proper relationship between headers. Louvres are adjustable and curved to direct heat downward. Grille or discharge nozzle may be used in place of louvres.

Herman Nelson Corp, Moline, Ill.

Corrosion-Resistant Valves

STAINLESS - STEEL, corrosion - resistant valves are made of Cooper 18-8 S and Cooper 18-8 SMO, each having a carbon content limited to a maximum of 0.10%. Both are highly resistant to corrosion, but Cooper 18-8 SMO is for most severe conditions, as for example, sulphite paper mills. Made in seven styles: solid wedge or double-disk gate valves, union-bonnet or bolted-bonnet regrind-

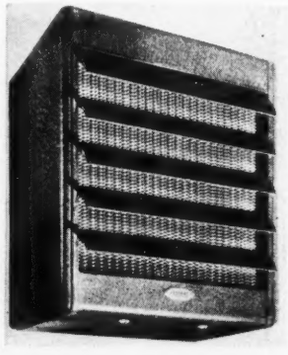


ing globe or angle valves, and bolted-bonnet Y valves; all either screwed or flanged, in sizes $\frac{1}{4}$ to 3 in.

Jenkins Bros, 80 White St, New York, N. Y.

Unit Heaters

SERIES 4 unit heaters made in 25 models ranging in capacities from 75 to 1200 sq ft. Included in improvements are: new cabinets embellished with integral beading; new heating elements with



double headers, providing free steam passages; new manifolds and improved full-floating mountings for eliminating expansion stresses and maintaining alignment between element and cabinet; streamlined tubes and individual convoluted fins.

Fedders Mfg Co, Buffalo, N. Y.

Paint Crayon

"DURAMARK," a brushless paint in stick form, will mark any surface: glass, metal, rubber, cement, etc. After mark is allowed to "set," it is said to be as permanent and durable as ordinary paint. Made in six colors: white, blue, red, yellow, green and black.

Eberhard Faber Pencil Co, 37 Greenpoint Ave, Brooklyn, N. Y.

ADVERTISING PAGES REMOVED

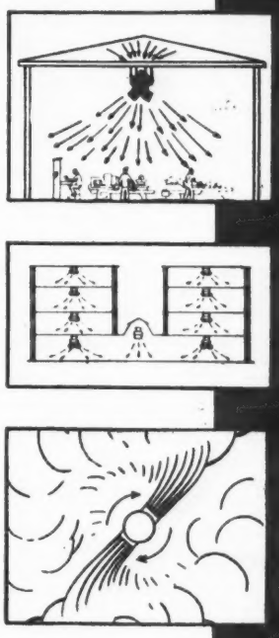
Development of the SCIENCE OF HEATING LARGE AREAS

Has for Years Been Led by

Wing *Featherweight* UNIT HEATERS *Floodlights of Heat*

Through constant improvement of methods of creating air turbulence and heat distribution.

1. Circulating air from the upper spaces, thus preventing accumulation of heat overhead.
2. Reheating and distributing it evenly and smoothly over the entire working area in a natural, healthy and comfortable manner.
3. Eliminating hot and cold spots and reducing heating costs.

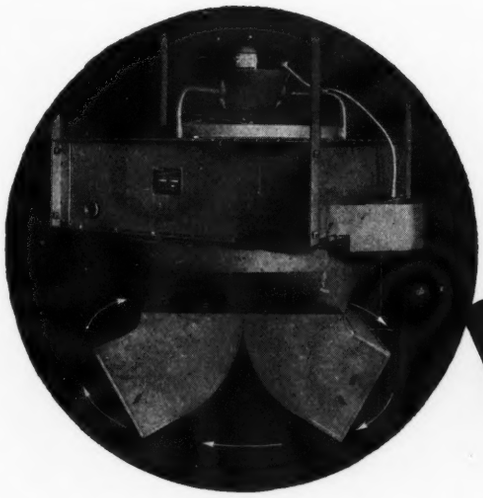


Specified by the Leading Architects. Used by the Largest Industries.
A Recognized and Highly Endorsed Pioneer Product.
Use the Original and Obtain all the Exclusive Features.
Our Field Engineers will gladly check your particular requirements.

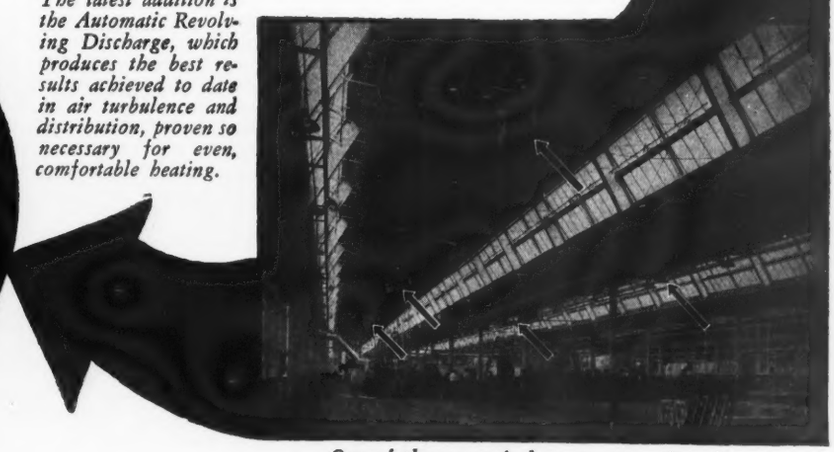
L. J. WING MFG. CO.

(The Pioneer of Ceiling-Suspended and Lightweight Unit Heaters)

West 14th St. & 7th Ave., New York, N. Y.



The latest addition is the Automatic Revolving Discharge, which produces the best results achieved to date in air turbulence and distribution, proven so necessary for even, comfortable heating.



One of the country's largest automotive plants.

Chief . . .

A LONG TIME ago, I told of the sergeant who, asked what the lieutenants watching him drill the company were for, said, "When the time comes, they show us how to die!"

The same tradition that bred these words bred the captains who are last to quit their sinking ships, the radio operators who defy death to send a last desperate SOS, the Grant who insisted he'd "fight it out on this line if it takes all summer," the Jones who shouted, "Surrender? Hell, we haven't yet begun to fight!"

These last were not humble men—they were leaders who were supposed to do what they did. But the late rancher-author, Eugene Manlove Rhodes, told three stories that prove even the worst of men remember the tradition. The *Saturday Evening Post* reported them recently.

Tom O'Folliard, the fifth man to try to run the gauntlet of thirty crack shots who had cornered Billy the Kid and his gang, saw the first four shot down. But O'Folliard, making his dash, halted by the body of his friend, Harvey Morris. He picked Morris up, saw that he was dead, ". . . and laid his body gently down." He didn't drop the body—with his own life at stake, he laid his friend's body down. The thirty men watched—and let him go. Each preferred to let someone else fire the fatal shot.

The Harrington boys, train robbers one jump ahead of a posse and on tired horses, saw two figures riding in the moonlight ahead—their chance for fresh mounts. But as they rode up they saw the two were young girls, riding the long way home. The Harrington boys, fugitive killers, turned aside, touching their hats gravely and saying, "Good evening, girls!" An hour later the posse caught them. But in the forty years since, no man has mentioned the names of these two dead thieves except with pride.

Felix Knox was a tinhorn gambler, but like Bret Harte's exile from Poker Flat, when his number came up, he knew how to die. Driving with his wife over the top of a hill outside Silver City, Felix saw Na-Chis and his Apaches coming. Whirling the buckboard around, he handed the reins to his wife and slipped his rifle from its scabbard. As he jumped out, "Goodbye, Mary," said Felix Knox, "Use the whip!" He turned back alone to hold the Indians. Next day, when searchers found his body, he hadn't been scalped, and over him lay the blanket of Na-Chis—a chief's blanket.

There is little chance for any of us to die amid gunfire, little chance even to save a lass from a burning building. But remember that Na-Chis was a chief too, proved so not by his dying but by a series of tests of his strength, his leadership, his willingness to die if need be. We have today the captains of ships who never have to prove their ability to lead by dying, and the chief engineers on land and sea who are acknowledged so by their men.

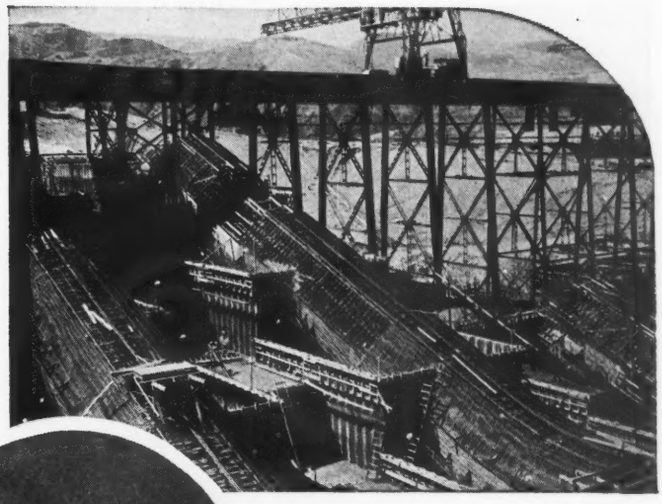
Maybe it's more a matter of being ready to die than actually dying—a matter of showing, through a thousand little things, the ability to lead. It means a willingness to take responsibility, to order no man to do that which you wouldn't do yourself, to plunge in fearlessly when the need arises, in other words to have the sand and grit to do what should be done. That, too, is part of the tradition. Felix Knox didn't become a chief by dying—he had what it takes deep down inside all the time.

George Edwards

Engineer

HARNESSING

550,000
CU. FT. PER SEC.
OF
RAGING RIVER



WITH THE AID OF

ALLOY NICKEL STEELS

More exciting than a Wild West Round-up is this taming of the Columbia River where it races seaward at a rate of 550,000 cu. ft. per sec.

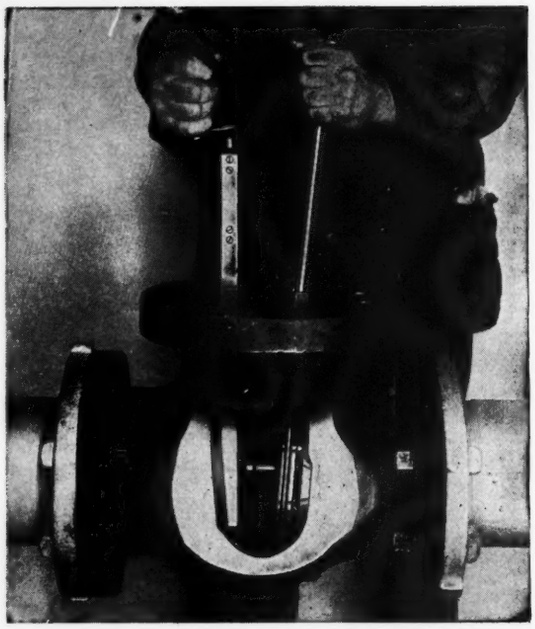
Harnessing the Columbia at Grand Coulee, Wash., is the largest engineering feat ever undertaken. This dam, more than 4/5 of a mile across and more than 1/10 of a mile high, contains *three times more concrete* than Boulder Dam. On every hard job, Nickel plays an important role.

Lifting materials 550′ above bedrock required in hoisting machinery the extra strength of SAE 2330 3½% Nickel steel, tested to 100,000 p. s. i. Other vital parts of hoisting equipment were forged from SAE 3140 Nickel-chromium steel, tested to 105,000 p.s.i.

For the battery of 17′ paradox gates and bulkhead section ring follower gate leaves, cast Nickel steel was selected to withstand pressure, erosion and wear. With double annealling, this 1% Nickel cast steel had to withstand a 120° bend and show a tensile strength of 80,000 p. s. i. SAE 3240 Nickel-chromium steel was used for stems in paradox gate hoists. For stem extension caps, wedge and jaw pins, case hardened SAE 2315 3½% Nickel alloy steel was specified.

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.

Picture a man Saving real money!



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Readers' Problems

(*Continued from page* 106)

brush or spray gun. I have so used it to retard pitting in the drums of water-tube boilers, with a marked degree of success. Upon taking the boiler down for washing after two weeks of operation, I have often found flecks of lead at the bottom of old pits, although the surfaces had always washed clean.

Since linseed and other paint oils are easily attacked by alkali compounds much used in feedwater treatment, red lead for boiler use is best if secured dry-ground, mixed with turpentine or rapid drier and a minimum of oil, and applied in very thin coats. At least two and preferably three coats should be used. One thick coat will peel as soon as heat is applied, and the lead may appear in the gage glass.

Marissa, Ill. GEORGE BLUM

More Lost Than Gained

IN REGARD to red-leading tube sheets, the red lead would be some help in case the boilers were to be layed up for some time. As to the prevention of scale, I don't believe that much is to be gained, as the scale would form over the red lead anyway. That was the lesson we learned a few years ago, and on top of that, a bag formed on one of the boilers about two weeks after the boiler in question was fired up. It is our belief that there was some oil that through negligence got on the sheet and caused the bag. It is pretty hard to mix paint of any kind without oil, therefore I believe that more would be lost in using the red lead than would be gained.

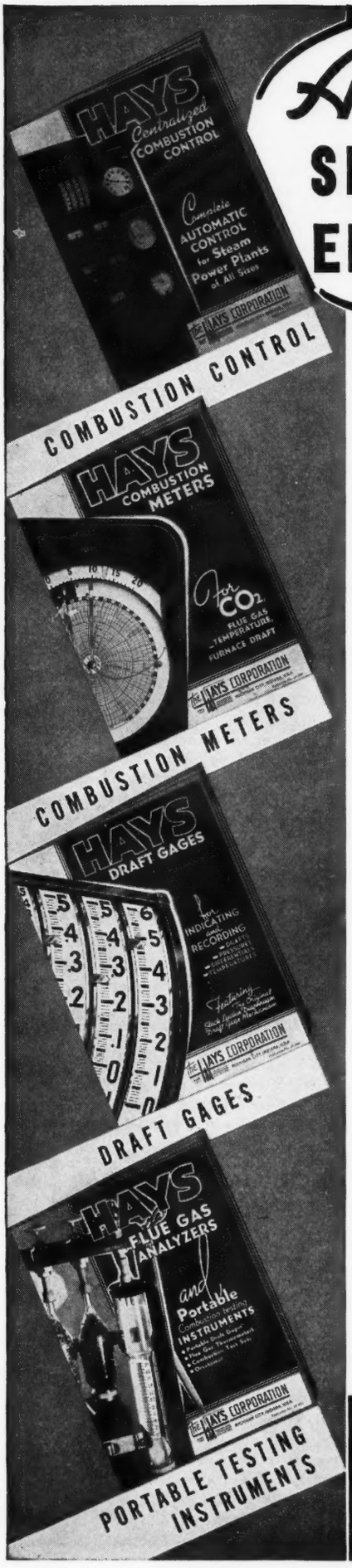
Sloat, Calif. R L BROWN

Good Practice

IT IS good practice to paint not only the tube sheets, but the entire heating surface of boilers of all descriptions, and if the proper mixture of paint ingredients is used, the coating will not wash off or burn off, even at pressures in excess of 150 lb.

A good mixture for this purpose is naphtha, gilsonite, red lead, and powder graphite, in the following proportions: 80% naphtha, 10% gilsonite, 4% red lead, and 6% deflocculated graphite. The naphtha used is not cleaner's naphtha. If ordinary naphtha cannot be obtained, oleum spirits can be substituted. Gilsonite is a pure form of asphaltum paint. The red lead is the ordinary product ground in oil. The graphite used must not be of the flake form but ground to an impalpable powder commonly referred to as deflocculated graphite. This will give a thin paint that flows readily.

The best procedure is to first remove scale, then wire brush, then apply the paint. After twelve hours a second coat can be applied. If two coats are applied, paint will remain on the heating



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WHY THIS RULE?

SAFETY-VALVE LIFTING LEVERS

THE LAWS in some municipalities require that each safety valve be lifted from its seat, either by raising the steam pressure to the popping point, or by means of the lifting device, at least once each day the boiler is in operation. This is an excellent safety rule, and this practice is recommended in all plants.

Too frequent popping of safety valves is indicative of poor plant operation. This is, however, carried to the opposite extreme in many cases, and even the occasional sound of a safety valve popping brings censure to the engineer from those having more authority than technical knowledge.

The latter condition occurs most frequently in sections having lax boiler regulations or no regulations at all. Too often in these cases, the lifting of the safety valve by hand is neglected, and the valve does not leave its seat for weeks at a time. It is easily possible for the valve to become stuck to its seat, or bound in the spindle guide by gummy dust deposits under such conditions. The possibilities of serious trouble can then be easily seen.

The second part of the quoted rule deals with types of lifting devices which may lock the valve in a lifted position. This might happen in venting an off-coming boiler, thus reducing pressure much too fast for proper stress changes throughout the boiler.

Also, blocking open the safety valve on a boiler not under pressure may lead to trouble. Often, the valve is blocked open—possibly for a vent—and it may remain thus for many days. This causes the safety valve spring to take a "permanent set," throw off accurate adjustment, and often permanently damage proper action of the spring.

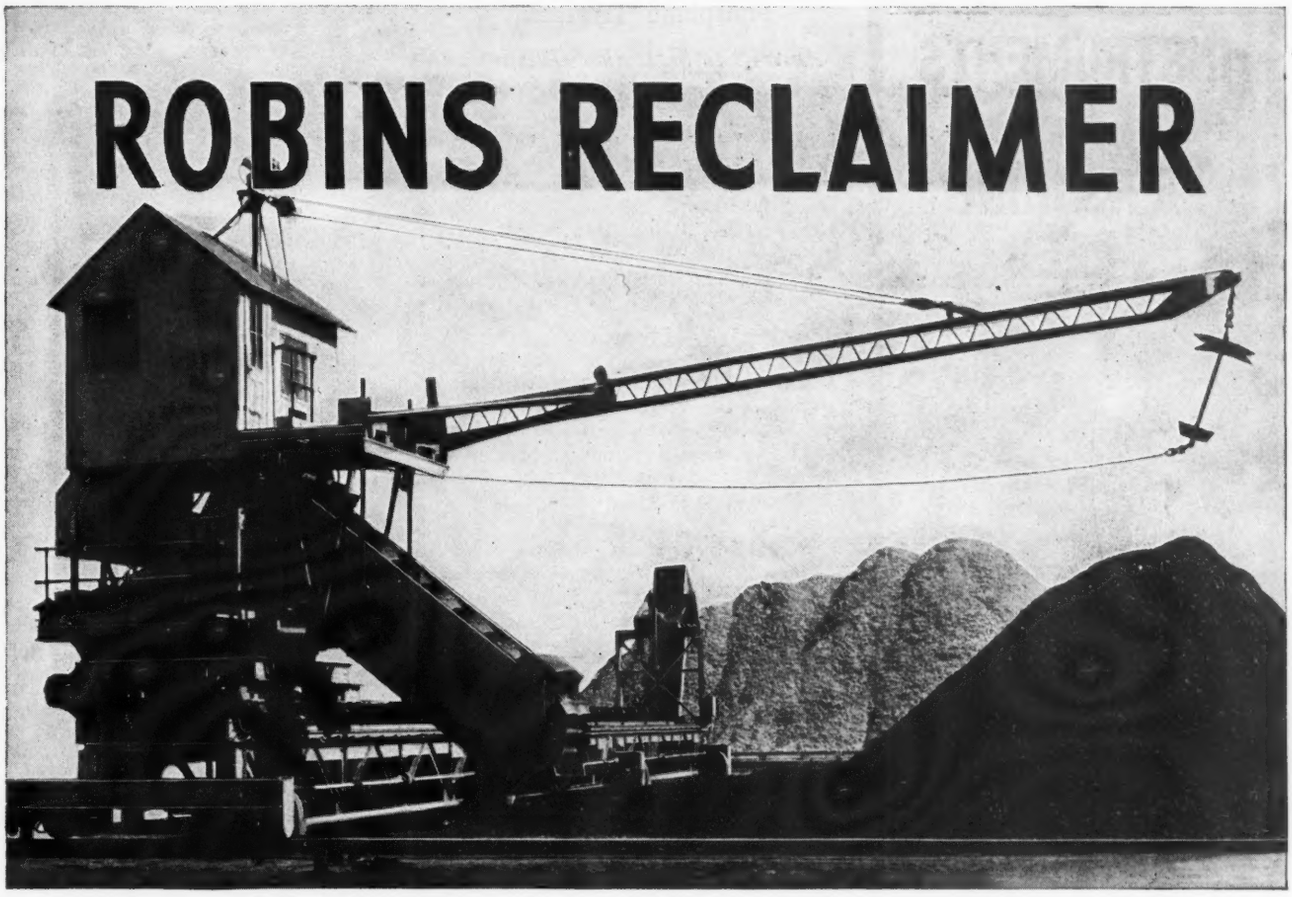
---

surfaces indefinitely, protecting the metal against corrosion and inhibiting further scale formation. If any scale does develop while boilers are in service, it is easily removed with a scraper. One advantage of this type of paint is that it will penetrate through and under any old scale that has not been removed in the scaling process. After standing for some time, the graphite has a tendency to settle out. It is good practice to keep stirring this mixture at frequent intervals to keep the graphite and red lead in suspension.

As the naphtha makes this paint highly inflammable, it cannot be used near an open flame, and the workman applying it to the interior of a boiler must have adequate ventilation. The use of this paint is common practice in large power boilers of the water-tube type and is applied each time the internal surfaces are cleaned. I have known this coating to adhere to surfaces in steam drums for a period of two years and still be intact. A special brush fastened directly to the air-driven tube cleaner is used for applying this paint to water tubes.

St. Louis, Mo. A F RIEBER

ROBINS RECLAIMER



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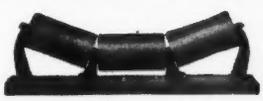

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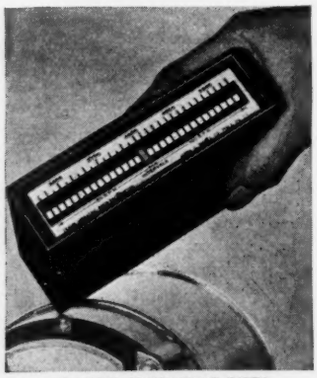

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Phosphate Treatment

Answers to September Question 2

The Question

OUR FEEDWATER *contains 25 ppm silica, 10 ppm iron, and 51 ppm of non-incrusting solids. Can some* POWER *reader tell me if phosphate will keep our boilers clean? If so, should it be trisodium or disodium phosphate? How should I figure the amount to be used?—JDO'N*

Need More Data

QUESTION 2 on "Phosphate Treatment" in September POWER is in itself three questions. First: will phosphate keep the boilers clean? Second: should it be tri-sodium or di-sodium phosphate? Third: how should the amount used be figured?

None of these three questions can be answered intelligently on the basis of the information given. A full knowledge of water composition is necessary so that the equilibrium factors can be determined with the use of phosphate or any other chemical treatment. The degree of dissociation of the various ions, as well as the pH of the water will, among other things, determine whether it should be tri-sodium, di-sodium or mono-sodium, or some other of the phosphates.

If JDO'N will give a complete analysis of the water the question can be more fully answered, provided there is also given some plant information, such as operating pressure.

New York, N. Y. S F CONEYBEAR

Suggests Filter

THE TREATMENT suggested by JDO'N might aid his problem, but it would have to be watched and checked closely or a more troublesome condition might arise. The proper way to treat this water is through a purifier where steam passes up and water down through a series of excelsior filters. This brings feedwater to a temperature as high as 212 F, and at this point the solids would be left in the excelsior.

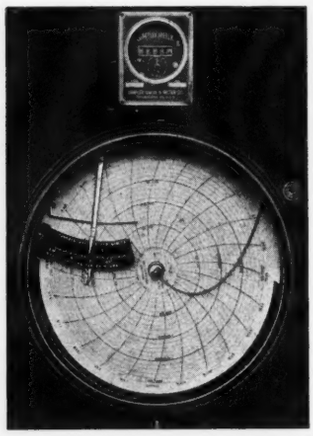
This system is used extensively in the oil fields where boiler feedwater at its best contains many times the amount of solids listed in the question. No chemicals or other treatments are necessary when this system of purification is used.

Los Angeles, Calif. A C ELDER

Need Specialist

JDO'N has asked quite a question and has not given enough information. What is the size of his boiler? Is his makeup 100% raw water or does he have some condensate returns? What is the quantity of raw makeup water? Without this data, it is impossible for anyone to give him an idea of how much phosphate to use. Silica is all that should give him any scale difficulties, and phosphate, in any of its forms, will effectively remove silica deposits. Whether he should

SIMPLEX FLOW METERS



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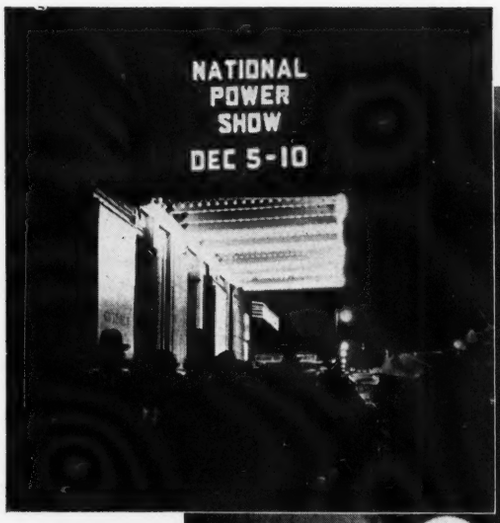

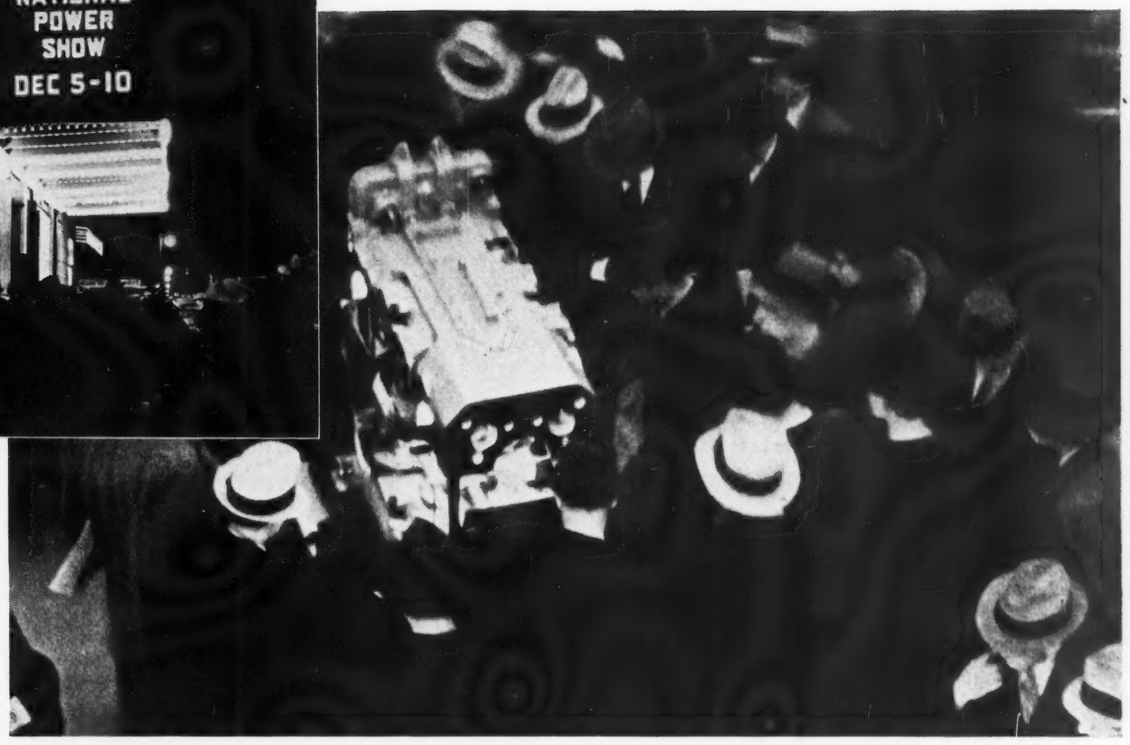

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More than 40,000 engineers and executives are expected to attend this outstanding biennial event during the week beginning December 5. After that, you will not for another two years have such an opportunity to learn as much, in one short week or less, about modern equipment and supplies for the efficient generation, transmission and use of power.

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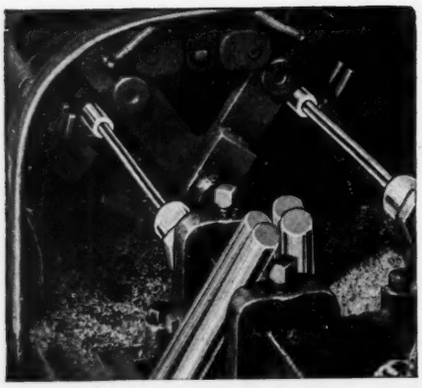

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use tri-sodium, di-sodium, or mono-sodium phosphate is a matter of alkaline concentration which he wishes to maintain. Judging from the type of water he has, it would appear that he should use a metaphosphate so that he can maintain his proper carbonate-sulphate ratio.

The control of phosphates in boiler water is covered by various patents and is also complicated and I would advise JDO'N to get in touch with a feedwater specialist and follow his advice. It is a grave error for any engineer to promiscuously dope up his boiler with a miscellaneous lot of chemicals, for nothing but trouble can result. The treatment of boiler feedwater has become an exact science and while all the sodium phosphates are used extensively for the treatment of silica-bearing water, it should be under exact control and these controls are all patented by various feedwater specialists.

St. Louis, Mo. A F RIEBER

Engineers' Books

(*Continued from page* 95)

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BRIEF REVIEWS

ELECTRIC POWER STATISTICS—1937 (1938). *Published by Federal Power Commission, Washington, D. C. Price not stated.*—A statistical bulletin on production of electric energy, installed capacity of generating plants, consumption of fuel, imports and exports of electric energy.

BALL AND ROLLER BEARING LUBRICATION (1938). *Published by The Texas Co, 135 E 42nd St, New York, N. Y. Available on request.*—Describes application of these bearings and their construction, and makes recommendations for their care and lubrication.

FATIGUE TESTS OF RIVETED JOINTS (1938). *Published by Engineering Experiment Station, University of Illinois, Urbana, Ill. Price $1.*—A report of an investigation conducted by the U of I Engrg Experiment Station in cooperation with The California Dept of Public Works, in which results of exhaustive tests made on riveted joints are published.

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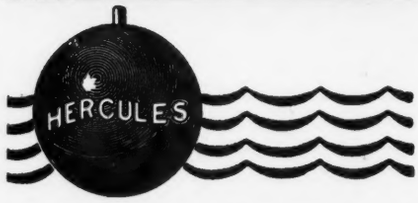

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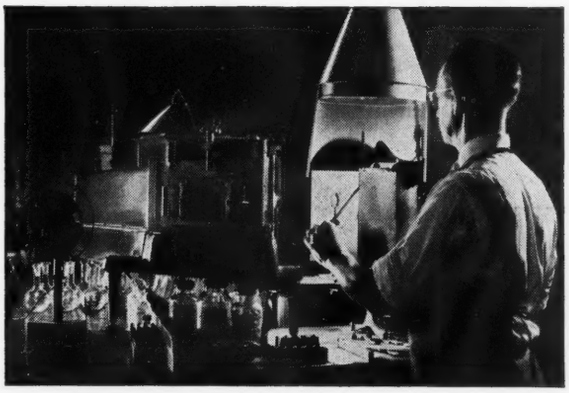

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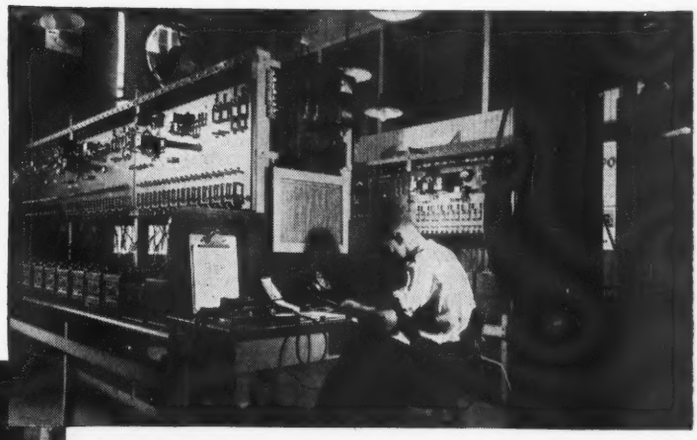

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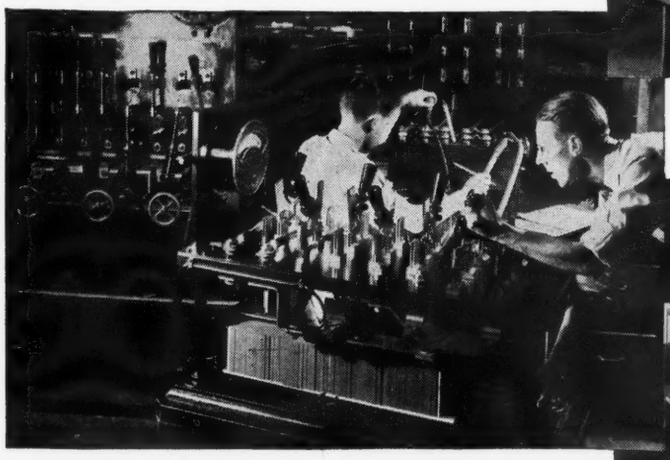

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Exide photographs important battery materials through the microscope.

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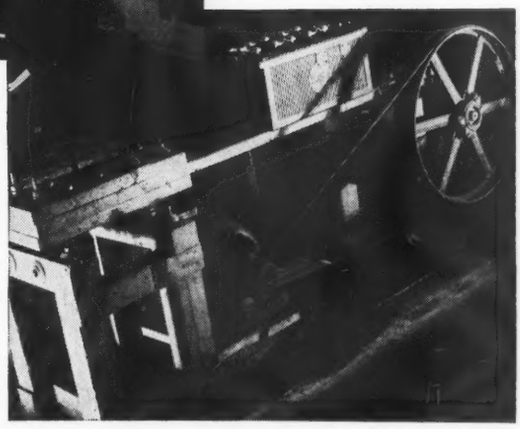

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That's the obvious solution to any problem—and especially boiler troubles such as priming, foaming, scale formation, and carry over. Remove the cause—yes, but how?

The Henszey Continuous Blowdown system will maintain your boiler water concentration at a pre-determined proper degree by drawing off the accumulated impurities. And, remember this—that blowdown is done continuously, automatically and *without heat loss*, with a Henszey System!

Write for further information.

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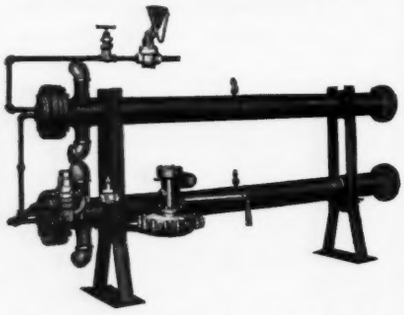

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HENSZEY

BOILER WATER CONCENTRATION CONTROL SYSTEMS

STRAWS

(*Continued from page* 100)

CONNECTICUT —— Board of School Trustees, Suffield, plans central-heating plant in 2-story high school. Cost about $180,000. Financing through Federal aid. William T Marchant, 36 Pearl St, Hartford, architect.

COLORADO——Fort Morgan plans expansion in municipal electric plant. Cost about $300,000. Financing through Federal aid.

Grand Junction plans new water-purification plant for municipal water system. Cost about $166,000. Financing through Federal aid. Black & Veatch, 4706 Broadway, Kansas City, Mo., consulting engineers.

Lamar plans improvements in municipal electric plant. Cost about $200,000. Financing being arranged through Federal aid. Burns & McDonnell Engrg Co, 107 W Linwood Blvd, Kansas City, Mo., consulting engineer.

FLORIDA —— Sanford plans municipal electric plant and distributing system. Cost close to $300,000. Financing being arranged through Federal aid. Burns & McDonnell Engrg Co, 107 W Linwood Blvd, Kansas City, Mo., consulting engineer.

Vero Beach Ice & Cold Storage Co, Vero Beach, plans 1-story ice-manufacturing and cold-storage plant. Cost close to $50,000 with equipment.

Port Everglades Refrigerating Co, Fort Lauderdale, plans 1-story cold-storage and refrigerating plant, 50 x 135 ft. Cost over $80,000, with equipment. George Kittridge, president.

United Gypsum Co, 300 W Adams St, Chicago, Ill., plans power house at new wallboard and gypsum building-products mill on Trout River, Jacksonville. Total cost about $1,000,000.

ILLINOIS——State Hospital Dept, Springfield, Ill., is arranging fund of $54,900 through Federal aid for power house at state hospital at Elgin, including boiler units and accessories.

Cold Storage Locker Corp, Byron, has leased 1-story buildings to be erected at Polo and Oregon, and will occupy for new cold-storage and refrigerating plants, with locker systems. Each unit will cost over $25,000. Work will begin at once. Carl Hauber, 25 E Jackson Blvd, Chicago, architect.

State Hospital Dept, Springfield, plans power house at state hospital at Alton. Cost about $78,750 with equipment. Financing through Federal aid.

INDIANA——Bluffton contracted Theodore H Buesching & Son, 1001 E Berry St, Fort Wayne, for extensions in municipal electric plant, at $18,925, exclusive of equipment. R W Noland, Medical Arts Bldg, Fort Wayne, consulting engineer.

Garrett has plans maturing for improvements in municipal electric plant, including installation of new 5000-sq ft water-tube boiler and accessories, automatic stoker, cooling tower, and miscellaneous equipment. Cost about $84,000. Financing through Federal aid. Bevington-Williams, Inc, Indiana Pythian Bldg, Indianapolis, consulting engineer.

IOWA——Remsen will award contracts soon for a 450-hp diesel-generator unit and auxiliary equipment, for municipal electric plant, where expansion will be carried out. $56,000 has been arranged. Buell & Winter Engrg Co, Insurance Exchange Bldg, Sioux City, is consulting engineer.

Dr K G Walker, Tipton, and associates plan 1-story cold-storage and refrigerating plant on local site, with installation of a locker system of about 425 units. Cost close to $35,000, with equipment.

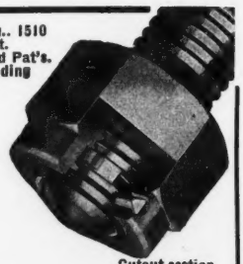
Cascade plans municipal electric plant. Proposed to install diesel-generator units and accessories. Cost about $110,000. Financing being arranged through Federal aid. Young & Stanley, Muscatine, consulting engineers.

Rolfe plans municipal electric plant. Cost close to $100,000, of which $44,550 will be Federal grant. Young & Stanley, Muscatine, consulting engineers.

KANSAS——Girard plans expansion in municipal electric plant and waterworks station, with installation of considerable new equipment. Cost about $138,000 Financing being arranged through Federal loan and grant. E T Archer & Co, New England Bldg, Kansas City, Mo., consulting engineers.

ANY WAY YOU LOOK AT IT . .

Fig.. 1510 Pat. and Pat's. Pending



Cutout section shows locking ring in place

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Fyr-Feeder has further money saving advantages—lower operating costs—flexible operation — steady steam pressure — increased boiler capacity. Reduces banking losses — Eliminates expensive maintenance.

Data sheet No. 41 shows how four Fyr-Feeder equipped plants have made savings averaging 31.7% even though all four plants previously had stoker equipment. Write for your copy of this interesting sheet and bulletin 77 which describes the Fyr-Feeder in detail.

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The biggest little thing in the power plant
LAGONDA-LIBERTY TUBE CLEANERS
are not built as large as this but they would be if there was need for them. They do come in all required sizes and types for any job of cleaning tubes or pipes.
Y-133

No, in spite of the picture, tube cleaners do not reach up to the skies in physical stature, but you'd think they do, considering the effect they have on operating costs. An eighth-inch of boiler tube scale can do pretty awful things to the fuel bill, but a good Lagonda-Liberty tube cleaner can even things up again by chasing out the scale.

It doesn't matter a great deal what type of scale is formed by your local water conditions. It's all tough stuff anyway — only some kinds are tougher than others. The best of it is that some types of Lagonda-Liberty cutter heads bite harder than others on the tougher varieties of scale, and all you need do is use the right cutter head. Lagonda-Liberty motors, too, vary to suit different conditions, and will combine with any selected cutter head to drive the job through quickly to a clean finish. The secret is simply to decide upon the correct combination of cutter head and motor, put them to work and let Nature take its course. In making this selection Lagonda-Liberty scale-removal experts are glad to help you.

Cleaners for condenser tubes, too, and other small tubes, as well as for pipes up to 20 in. inside diameter. Enduring, heat-resisting, abrasion-defying hose, and other accessories. Write us for the Tube Cleaner Bulletin.

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SPRINGFIELD, OHIO

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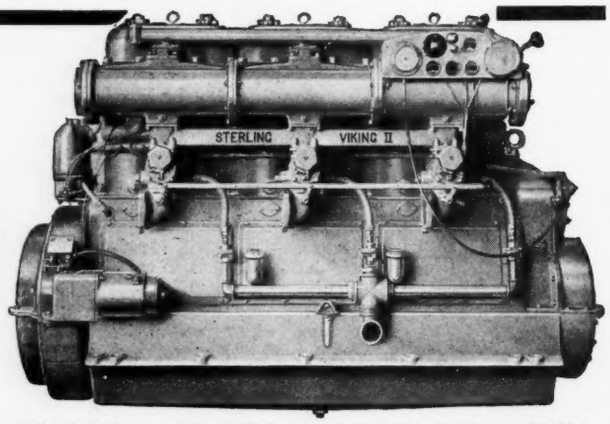

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Installations in power and process plants on high pressure, high temperature pipe lines are proving the safety and economy of W-S Fittings.
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THE WATSON-STILLMAN CO.
ROSELLE, N. J.

Wamego plans extensions in municipal electric plant, including new engine unit and accessories, switchboard and auxiliary equipment. Cost about $50,000, of which $20,875 will represent a Federal grant. Paulette & Wilson, 1006 Kansas Ave, Topeka, consulting engineers.

Canton plans municipal gas plant. Cost about $37,000, with equipment. Financing being arranged through Federal aid. Hefling & Hunter, E Second St, Hutchinson, consulting engineers.

KENTUCKY——Corbin plans extensions in municipal electric plant, waterworks station and system. Cost about $400,000. Financing through Federal aid. Burns & McDonnell Engrg Co, 107 W Linwood Blvd, Kansas City, Mo., consulting engineer.

MASSACHUSETTS——Board of School Trustees, Springfield, John Granrud, superintendent of schools, plans central-heating plant in new 4-unit trade school. Cost $1,440,000. Financing has been arranged in part through Federal aid. John A Facey, 7 Kimberly Ave, and A G Wylie, 47 Westford Circle, both Springfield, are mechanical and electrical engineers, respectively.

MICHIGAN——Water Bureau, Grand Rapids, plans pumping machinery and other power equipment in connection with new water-supply system. Fund of $4,100,000 has been arranged through Federal aid. Consoer, Townsend & Quinlan, Inc, 205 W Wacker Dr, Chicago, Ill., consulting engineer.

Zeeland plans extensions in municipal electric plant. Cost about $55,000. Financing through Federal aid. Ayres, Lewis, Norris & May, Ann Arbor, are consulting engineers.

Ottawa-Allegan Electric Co-Operative, Inc, Burnips, plans power plant on 2-acre tract of land near Burnips, recently acquired, for power service for rural electric system. Cost about $30,000. Work is scheduled to begin soon.

State Department of Institutions, Lansing, plans power house at institution at Coldwater. Cost about $325,000, with equipment. E R Little Co, Inc, Ford Bldg, Detroit, consulting engineer.

Ypsilanti has low bid at $117,698 from Strandberg & Spencer, 232 E Erie Ave., Chicago, Ill., for installation of water-purification plant for municipal water system, and award is scheduled to be made soon. Shoecraft, Drury & McNamee, Ann Arbor, consulting engineers.

Saginaw is considering financing in amount of $6,000,000, partially through Federal aid, for proposed municipal electric plant and electrical distribution system. Installation will include steam turbine-generating units, high-pressure boilers and auxiliary equipment. Burns & McDonnell Engrg Co, 107 W Linwood Blvd, Kansas City, Mo., consulting engineer.

Wyandotte plans improvements in municipal electric plant. Cost about $387,000. Financing through Federal aid. Smith, Hinchman & Grylls, Inc, Marquette Bldg, Detroit, consulting engineer.

MINNESOTA——Minneapolis will soon award contract for boiler unit and auxiliary equipment for central-heating plant at municipal shop at 1308 Currie Ave. Cost about $183,000. Financing being arranged through Federal aid. Fred T Paul and A M Larson, both City Hall, engineer and architect, respectively.

City Meat Market, St. James, Joseph Menne, head, plans 1-story L-shaped addition to cold-storage and refrigerating plant, with locker system of about 300 units. Cost over $40,000, with equipment.

Eyota has authorized surveys and estimates of cost for municipal electric plant, and electrical distributing system. Financing will be arranged soon. Burlingame, Hitchcock & Estabrook, Inc, Sexton Bldg, Minneapolis, consulting engineers.

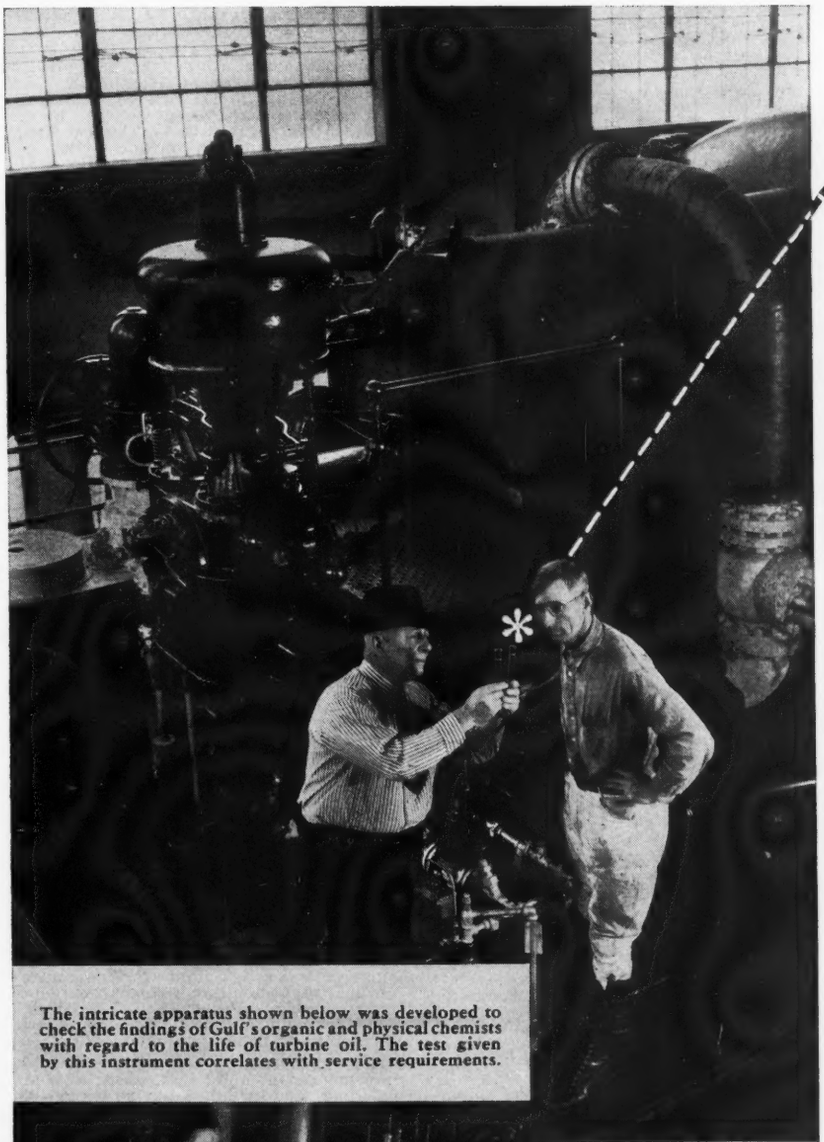
Wood Conversion Co, Cloquet, contracted Fegles Construction Co, Wesley Temple Bldg, Minneapolis, for alterations in power house at factory, including new boiler. Ralph D Thomas & Associates, 1200 Second Ave, South, Minneapolis, consulting engineers.

Chicago & Northwestern Railway Co, 400 W Madison St, Chicago, Ill., plans new boilers and auxiliary equipment in power house at shops at Winona. Work will be carried out early in 1939.

Breckenridge contracted Sterey & Anderson, Breckenridge, for addition to municipal electric plant. Work will be placed under way at once. Cost over $30,000 with equipment.

"GULFCREST OIL is making an outstanding record"

...SAYS CHIEF ENGINEER



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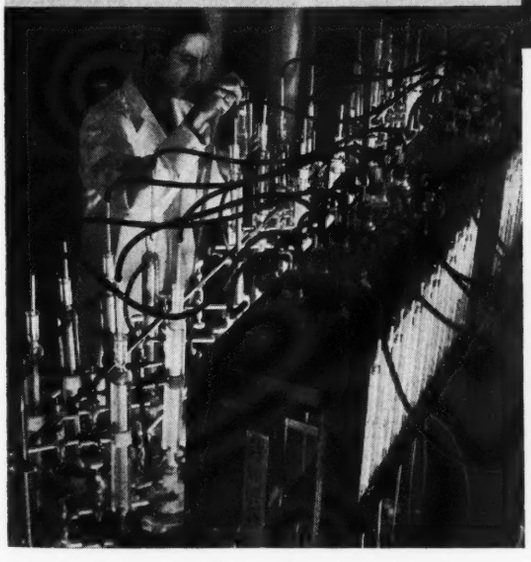

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Alexandria will award contracts soon for equipment for municipal electric and central steam-heating station, including new boiler unit and accessories, coal- and ash-handling system, stoker, combustion-control apparatus and auxiliary equipment. Cost about $162,400. Financing through Federal aid. Burlingame, Hitchcock & Estabrook, Inc, Sexton Bldg, Minneapolis, consulting engineer.

MISSISSIPPI——Lexington plans municipal ice-manufacturing and cold-storage plant. Bond issue of $20,000 being arranged; additional financing through Federal aid.

Clarksdale plans extensions in municipal electric plant, including two 6000-sq ft boilers. Cost about $186,000, of which $83,700 will be a Federal grant. Work is scheduled to begin soon.

Canton plans improvements in municipal electric plant. Cost about $47,000. Financing through Federal aid.

MISSOURI——Clarksville plans municipal electric plant. Proposed to use diesel-generator unit and accessories. Cost about $66,000, of which $36,300 will be a bond issue, recently approved, and remainder a Federal grant.

Kirkwood plans expansion in municipal electric plant. Cost about $100,000. Financing being arranged through Federal aid.

West Plains plans municipal electric plant. Proposed to install diesel-generator units and auxiliary equipment. Cost close to $150,000. Financing being arranged through Federal aid. M S Hogan, city engineer, in charge.

Monroe City plans improvements in municipal electric plant, including 500-kw diesel-generator unit and auxiliary equipment. Fund of $72,000 has been arranged, of which $32,000 will be a Federal grant.

NEBRASKA——North Platte is considering municipal electric plant. Cost over $100,000, with equipment. Financing will be arranged through Federal aid. C Robert Fulton, 2327 S 19th St, Lincoln, is consulting engineer.

Hyannis is arranging financing through Federal aid in amount of $32,290, for extensions in municipal electric plant. Black & Veatch, 4706 Broadway, Kansas City, Mo., consulting engineers.

NEW JERSEY——Camden plans municipal pumping station for waterworks system, using diesel pumping units and accessories. Cost about $385,000. Financing being arranged through Federal aid. Burns & McDonnell Engrg Co, 107 W Linwood Blvd, Kansas City, Mo., consulting engineer.

NORTH DAKOTA——State Board of Administration, Bismarck, A B Welch, executive secretary, plans improvements in power house at institution at Jamestown, including electric generator unit, boilers, stokers, pumps and auxiliary equipment. Cost about $154,500. William F Kurke, 1117 13th Ave, North, Fargo, consulting engineer.

OHIO——Orrville plans water-softening plant for municipal waterworks. Cost about $72,000. Financing is being arranged through Federal aid. Gascoigne & Associates, Leader Bldg, Cleveland, consulting engineers.

Clyde plans extensions in municipal electric plant, including turbine unit, cooling tower and other equipment. Cost about $154,000. Financing through Federal aid. Froehlich & Emery Engrg Co, Second National Bank Bldg, Toledo, consulting engineer.

Western Bank & Trust Co, 12th and Vine Sts, Cincinnati, plans air-conditioning plant and system for bank building, in connection with remodeling and improvements in structure. Tietig & Lee, 34 E Sixth St, and Fosdick & Hilmer, Union Trust Bldg, both Cincinnati, are architects and engineers, respectively.

Piqua has concluded financing through Federal aid for $450,000 for improvements in municipal electric plant. Contracts will be awarded soon. Burns & McDonnell Engrg Co, 107 W Linwood Blvd, Kansas City, Mo., consulting engineer.

Cadiz plans water-softening plant for municipal water system. Cost about $55,000. Equipment contracts will be let soon. Jennings & Lawrence, 12 N Third St, Columbus, are consulting engineers.

St. Marys plans extensions in municipal electric plant, and will award contracts soon. Cost about $90,000. Financing through Federal aid.

Port Clinton plans municipal electric plant. Cost about $300,000, of which $135,000 will be a Federal grant. Burns & McDonnell Engrg Co, 107 W Linwood Blvd, Kansas City, Mo., consulting engineer.

Wellston plans early call for bids for municipal electric plant, to supplement present municipal station, with installation of turbine-generator and accessories, boilers, pumps and auxiliary equipment. Cost about $180,000, of which $80,000 will be a Federal grant. F W C Bailey, Columbus, consulting engineer.

Bellefontaine plans improvements in municipal electric, gas and water plants. Cost about $154,500, of which $72,855 will be a Federal grant. J W Thatcher, service director, in charge.

Housing Authority, Department of Interior, Washington, D. C., has low bid at $36,164 from Spohn Heating & Ventilating Co., 1775 E 45th St, Cleveland, for extensions and improvements in central-heating plant at Cedar Central Apartments, Cleveland, to include boiler unit and auxiliary equipment. Award is scheduled to be made soon.

OKLAHOMA——Perry plans expansion in municipal electric plant. Cost about $82,000. Financing being arranged through Federal aid. V V Long & Co, Colcord Bldg, Oklahoma City, consulting engineers.

Chelsea plans improvements in municipal electric plant, including diesel and auxiliary equipment. Cost about $58,000. Financing through Federal aid. V V Long & Co, Colcord Bldg, Oklahoma City, consulting engineers.

Purcell plans municipal electric plant and waterworks station. Cost about $150,000. Financing being arranged through bond issue and Federal aid. E T Archer & Co, New England Bldg, Kansas City, Mo., consulting engineers.

Fairview will award contract soon for 700-hp diesel-generator unit and auxiliary equipment for municipal electric plant. E M Evans, Fairview, engineer.

OREGON——School District No. 40, McMinnville, plans central-heating plant in 2-story high school, with two oil-fired boiler units and auxiliary equipment. Cost over $130,000. Ertz-Burns, Inc, Pittock Block, Portland, architect.

Eugene plans municipal electric plant. Cost about $600,000 with turbine-generator and auxiliary equipment. Federal grant of $269,923 is being arranged to defray part of cost. H P Currin, superintendent of electrical department, engineer.

United States Engineer Office, Bonneville, has low bid from S Morgan Smith Co, York, Pa., at $1,584,144 for two hydraulic turbines for Bonneville hydroelectric plant, and award is scheduled at early date. Also low bids from Woodward Governor Co, Rockford, Ill., for governors and governing equipment for units at $90,679 and $87,516, respectively, with awards to be made soon.

SOUTH CAROLINA——Laurens plans municipal electric plant for emergency service, supplementing present source of power supply. Proposed to use diesel-generator unit and accessory equipment. Financing is being arranged.

SOUTH DAKOTA——Tyndall plans improvements in municipal electric plant, including 200-kw diesel-generating unit and auxiliary equipment; also improvements in cooling system and other work. Financing being arranged through Federal aid. H S Nixon, Burt Bldg, Omaha, Neb., consulting engineer.

TENNESSEE——Tennessee Valley Authority, Knoxville, contracted Newport News Shipbuilding & Dry Dock Co, Newport News, Va., for 80,000-hp hydraulic turbine for Hiwassee hydroelectric plant, at $268,000. Also, let contract to Woodward Governor Co, Rockford, Ill., for governors and governing system for unit, at $26,240. Also contracted Chicago Bridge & Iron Works, Chicago, Ill., for two water-storage plants for Gilbertsville power dam for hydroelectric station, at $24,845.

TEXAS——Schulenburg plans municipal electric plant, using diesel-generating unit and accessories. Cost about $75,000. Financing is being arranged through bond issue and Federal aid.

Bastrop plans municipal electric plant, using diesel-generator unit and accessories. Cost about $58,000. Financing through Federal aid. Garrett Engrg Co, Houston, is consulting engineer.

Floyada plans municipal electric plant, using diesel-generator units and accessories. Cost about $150,000, of which $90,000 will be a Federal grant.